Interreg
España - Portugal
Fondo Europeo de Desarrollo Regional
Fundo Europeu de Desenvolvimento Regional

UNIÓN EUROPEA
UNIÃO EUROPEIA

nano GATEWAY

mission 10.000 conference

Batteries

October 10th - 11th, 2019

INL, BRAGA, PORTUGAL

Vol 2: Conference Proceedings nanoGateway Mission 10.000
Vol 2: Livro de Atas de Conferências nanoGateway Mission 10.000
Vol 2: Libro de Actas de la Conferencia nanoGateway Mission 10.000

ISBN 978-989-33-0412-9

ISBN 978-989-33-0412-9
Editor: International Iberian Nanotechnology Laboratory
Title: "*Mission 10.000: Batteries*"
Publication: Vol 2: Conference Proceedings of nanoGateway Mission 10.000;
Author: INL - Conference Office
Support: Electronic
Format: n.d.

Mission 10.000: BATTERIES

October 10th - 11th, 2019 | **INL**, Braga (Portugal)

nanoGateway International Conference

Mission 10.000: BATTERIES

Welcome to the nanoGateway International Conference Mission 10.000: Batteries

Battery storage represents a key component in Europe's decarbonization efforts and transition to sustainable energy. The electrification of vehicles and the widespread implementation of renewable energy will both challenge current battery technologies and demand future **battery technologies** with higher energy density, higher rate capability, lower cost, and lower environmental impact. Currently, Li-ion battery technology is the leading choice for electric vehicles (eVehicles) and electrochemical energy storage (EES) for the grid due to its energy density, cycle life, and decreasing costs. However, securing access to Li and Co is a major concern for the European Union, a significant driver for innovation in battery storage technologies. It is difficult to predict the dominant battery technology of the future, therefore efforts have been made to **develop a comprehensive EU strategy for battery storage research, innovation, and industry.**

The **Mission 10.000: Batteries** brought together researchers, innovators, and policy-makers to discuss the current and future trends in battery storage to help position the EU as a major player in the future battery storage market, a multi-billion euro market that is set to grow rapidly in the near future.

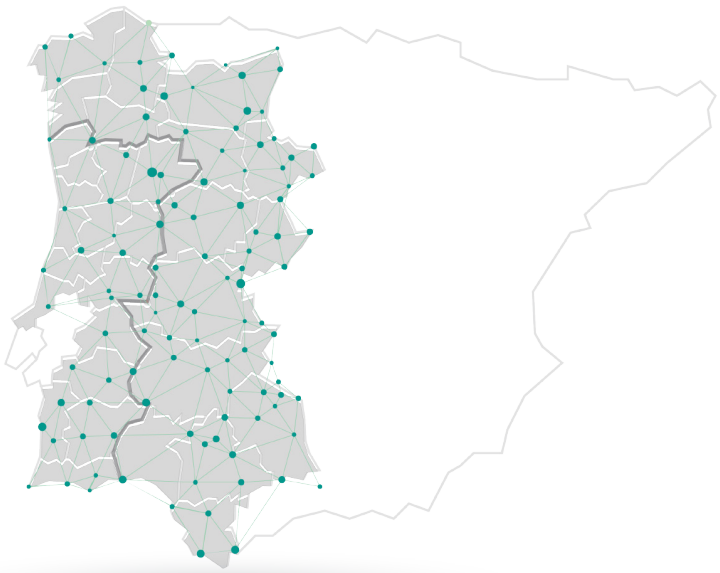
The nanoGateway Iniciative

Nanogateway is a collaborative multi-actor initiative to increase the impact of research in issues of social relevance, involving all the relevant actors to solve complex challenges. The topics of the conference are related to the applications of Key Enable Technologies (particularly nanotechnology) in the main areas of the Bioeconomy (agriculture, food and water resources).

The **nanoGateway project** is co-funded under the Interreg V-A Spain-Portugal Cooperation Programme (POCTEP) and is lead by the INL involving the POCTEP Regional Development Agencies.

INTERREG-POCTEP REGIONS

PORTUGAL
Alentejo Central
Algarve
Alto Alentejo
Alto Minho
Alto Tâmega
Área Metropolitana de Porto
Ave
Baixo Alentejo
Beira Baixa
Beiras e Serra da Estrela
Cávado
Douro
Médio Tejo
Oeste and Alentejo Litoral
Região de Aveiro
Região de Coimbra
Região de Leiria
Tâmega e Sousa
Trás-os-Montes
Viseu Dão-Lafões



ESPAÑA
A Coruña
Ávila
Badajoz
Cáceres
Cádiz
Córdoba
Huelva
León
Lugo
Ourense
Pontevedra
Salamanca
Sevilla
Valladolid
Zamora

Interreg España - Portugal
Fondo Europeo de Desarrollo Regional
Fundo Europeu de Desenvolvimento Regional

nano GATEWAY

mission 10.000 conference

Mission 10.000: BATTERIES

October 10th - 11th, 2019 | **INL**, Braga (Portugal)

nanoGateway International Conference

Welcome to the International Conference Mission 10.000: Batteries

Closing the cycle of the Mission 10.000 International Conferences, INL hosted the Mission 10.000: Batteries on October, 10th and 11th, 2019.

Battery storage represents a key component in Europe's decarbonization efforts and transition to sustainable energy. The electrification of vehicles and the widespread implementation of renewable energy will both challenge current battery technologies and demand future battery technologies with higher energy density, higher rate capability, lower cost, and lower environmental impact.

Currently, Li-ion battery technology is the leading choice for electric vehicles (eVehicles) and electrochemical energy storage (EES) for the grid due to its energy density, cycle life, and decreasing costs. However, securing access to Li and Co is a major concern for the European Union, a significant driver for innovation in battery storage technologies. It is difficult to predict the dominant battery technology of the future, therefore efforts have been made to develop a comprehensive EU strategy for battery storage research, innovation, and industry.

Over the course of two days, we had the pleasure of receiving 140 participants from all over the world, listening to 10 inspiring lectures from world-renowned speakers, participating in two stimulating round tables and watching various oral and poster presentations.

The Mission 10.000: Batteries conference was a resounding success, bringing researchers, innovators, and policy-makers together to discuss current and future trends in battery storage. Talks and posters ranged from fundamental beyond-Li-ion research to EU-level deployment of Li-ion battery industry. The decarbonization of the world's economy and the transition to sustainable energy are great challenges, but participants of the conference were armed with strategies and solutions. The development of these electrochemical energy storage technologies will open the door for millions of new jobs in powerful new industries, allow the EU to capture a larger segment of the world's battery storage market, and provide a better future for generations to come.

Sincerely,

Prof. Dr Lars Montelius,
DG, INL

INL
INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY

Interreg España - Portugal
Fondo Europeo de Desarrollo Regional
Fundo Europeu de Desenvolvimento Regional

nanoGATEWAY

mission 10.000 conference

Mission 10.000: BATTERIES

October 10th - 11th, 2019 | **INL**, Braga (Portugal)

nanoGateway International Conference

Scientific Committee

Lifeng Liu, INL – Chair
Paulo Ferreira, INL
Charles Amos, INL
Fátima Montemor, Instituto Superior Técnico
Sónia Eugénio, Instituto Superior Técnico
Oscar Crespo, CIDETEC
Enrique Romero-Cadaval, University of Extremadura
Adélio Mendes, University of Porto
Helena Braga, University of Porto
Senentxu Lanceros-Méndez, University of Minho and BC Materials

Managing Committee

Lars Montelius, INL – Chair
Sonia Pazos, INL
Luís Caetano, CCDR-Centro
Pedro Figueirido, CCDR-Norte
António Ramos, CCDR-Algarve
Patricia da Costa Félix Bermejo, FUNDECYT Junta de Extremadura
Jose Rivas, University of Santiago de Compostela
Joaquín Villar, Andalusia Energy Agency

Organizing Committee

Lifeng Liu, INL
Paulo Ferreira, INL
Charles Amos, INL
Fátima Montemor, Instituto Superior Técnico
Sónia Eugénio, Instituto Superior Técnico

Interreg España - Portugal
Fondo Europeo de Desarrollo Regional
Fundo Europeu de Desenvolvimento Regional

nano GATEWAY

mission 10.000 conference

Mission 10.000: BATTERIES

October 10th - 11th, 2019 | **INL**, Braga (Portugal)

nanoGateway International Conference

PROGRAMME | October 10th, 2019

8h00 - 9h00 Registration

OPENING SESSION

9h00 **Lars Montelius,** Director-General INL

9h10 **Ricardo Rio,** Mayor of Braga

09h20 **Welcome Message**

:: The European Battery Landscape

Charles Amos, Research Group of Atomic Structure-Composition of Materials (ASCM), INL

:: Competence Centers in Batteries at INL and IST

Lifeng Liu, Group Leader, Nano Materials for Energy storage and conversion, INL

Alberto Adán Más, Researcher, Department of Chemical Engineering, IST

09h50 **Video Interview with the lithium-ion battery pioneer John Goodenough,** Professor, Department of Mechanical Engineering, University of Texas at Austin

MORNING SESSION

INVITED TALK

10h00 ***:: European Battery Alliance - Building the European Battery Industry*** Policy

Thore Sekkenes, Program director for European Battery Alliance, InnoEnergy Scandinavia AB

10h45 Poster Session Presentations - Break

CONTRIBUTED TALKS

11h15 ***:: High Power Blue Lasers, a Disruptive Technology for Battery Welding ::*** **Victor Blanco,** Laser 2000 SAS / NUBURU

11h35 ***:: High-Capacitance Negative Electrode based on Cobalt Phosphide Nanocrystals ::*** **Nan Zhang,** INL

INVITED TALK

11h55 ***:: European Partnership on Advanced Materials for Batteries*** Policy / Science

Joaquín Villar, Head of Department, Internationalisation and Forsight, Andalusian Energy Agency

ROUNDTABLE DISCUSSION

Funding & Collaboration Opportunities

12h20 **Luís Maia**, Horizon 2020 National Delegate and Contact Point, GPPQ - Portuguese Framework Promotion Office

Joaquín Villar, Head of Department, Internationalisation and Forsight, Andalusian Energy Agency

Juliana Restrepo Sintes, Director General, AEPIBAL - Industrial Association for Batteries and Energy Storage | BatteryPlat

Moderator: Paula Galvão, Chief Business and Strategic Relations, INL

INL WORLDWIDE NETWORK & PARTNERS ANNUAL CONFERENCE

Interreg España - Portugal

mission 10.000 conference

Mission 10.000: BATTERIES

October 10th - 11th, 2019 | **INL**, Braga (Portugal)

nanoGateway International Conference

PROGRAMME | October 10th, 2019

13h20 Networking Lunch — Networking Opportunity

AFTERNOON SESSION

INVITED TALK

14h50 ***:: Fast Charging of Lithium-Ion Batteries*** — Science

Daniel Abraham, Senior Materials Scientist, Argonne National Laboratory

CONTRIBUTED TALKS

15h35 ***:: Free-Standing N-Graphene as Conductive Matrix For Ni(OH)2 Based Supercapacitive Electrodes ::*** **Kush Upadhyay, IST**

15h55 ***:: Compositional Mapping of LiNixCoyMnzO2 Cathode Materials ::*** **Cristiana Alves, INL**

16h15 Coffee break

INVITED TALK

16h45 ***:: Techology Transfer within the EU Batteries Ecosystem: our experience*** — Innovation / Industry

Oscar Miguel, Director, CIDETEC Energy Storage

INVITED TALK

17h30 ***:: Structural Characterization of Li-ion Battery Materials Using Advanced Electron Microscopy Techniques*** — Science

Karalee Jarvis, Research Engineering/Scientist, Univeristy of Texas at Austin

18h15 INL Tour / Happy Networking Hour

PROGRAMME | October 11th, 2019

8h30 - 9h00 Registration

MORNING SESSION

INVITED TALK

9h00 ***:: Batteries: Industrial Initiatives and Opportunities in Iberia*** — Policy

Mikel Lasa, CEO, InnoEnergy Iberia

CONTRIBUTED TALKS

9h45 ***:: How relevant is for Asset Operators to Access Cell Data in Large Scale Stationary Li-ion Battery Projects: the case of 2nd life Batteries ::*** **Mario Simões, EDP Inovação**

10h05 Poster Session Presentations – Break

INL WORLDWIDE NETWORK & PARTNERS ANNUAL CONFERENCE

Interreg España - Portugal

mission 10.000 conference

Mission 10.000: BATTERIES

October 10th - 11th, 2019 | **INL**, Braga (Portugal)

nanoGateway International Conference

PROGRAMME | October 11th, 2019

INVITED TALK

10h55 *:: From Thermal Harvesting to Electrical Storage in Li/Na Devices* — Science

Maria Helena Braga, Associate Professor, Department of Engineering Physics, University of Porto

CONTRIBUTED TALKS

11h40 *:: Nanoconfined Ionic Liquids and Hybrid Ionogels: Tuning the Electrolyte-Electrode Interface ::* **Luis Miguel Varela,** University of Santiago de Compostela

12h00 *:: Ionic Liquids: Next Generation Electrolytes ::* **Oscar Cabeza,** University of Coruña

INVITED TALK

12h20 *:: Printed and Solid-state Batteries: Materials, Challenges and Opportunities*

Senentxu Lanceros-Mendez, Scientific Director and Professor, Basque Center for Materials, Applications, and Nanostructures — Technology/Innovation

13h05 Networking Lunch — Networking Opportunity

AFTERNOON SESSION

INVITED TALK

14h35 *:: Batteries Interfaces for Renewable Energies and Electric Vehicles* — Technology/Innovation

Enrique Romero-Cadaval, Professor, Power Electric and Electronic Systems R&D Group, University of Extremadura

INVITED TALK

15h20 *:: Redox Flow Batteries: Present and Future Perspectives* — Science

Adélio Mendes, Professor, Department of Chemical Engineering, University of Porto

16h05 Coffee break

ROUNDTABLE DISCUSSION

:: Scaling Battery Innovations: now and tomorrow

Opportunities and challenges for the lithium ion battery value chain

16h30

António Silva, Geologist, Lusorecursos

Jorge Magalhães, Senior VP, Vestas

Mario Simões, Technology Expert in Energy Storage, EDP Innovation

Mikel Lasa, CEO, InnoEnergy Iberia

Moderator: Fátima Montemor, IST

17h30 **AWARDS SESSION**

Lars Montelius, Director-General INL

17h45 **CLOSING REMARKS**

Fátima Montemor, Professor, Department of Chemical Engineering, Vice-President of IST

INL WORLDWIDE NETWORK & PARTNERS ANNUAL CONFERENCE

Interreg España - Portugal

mission 10.000 conference

Mission 10.000: BATTERIES

October 10th - 11th, 2019 | **INL**, Braga (Portugal)

nanoGateway International Conference

Invited Speakers

:: DANIEL P. ABRAHAM

Senior Materials Scientist, Argonne National Laboratory

Daniel P. Abraham conducts research on lithium batteries used in electric vehicles, consumer electronics and grid energy storage in the Argonne National Laboratory. He has authored over 130 articles in peer-reviewed journals and delivered over 300 technical presentations in popular, academic, and industrial settings.

His work enables the development of materials and components that enhance lithium battery performance, life, and safety. He has a special interest from the discovery and development of electrode and electrolyte materials for sustainable and environmentally friendly batteries, to recycling existing lithium-ion cells to recover non-renewable components.
Dr. Abraham has received the Outstanding Postdoctoral Supervisor Award and the Pinnacle of Education Award for "exceptional work in developing the next generation of scientists and engineers."

:: HELENA BRAGA

Associate Professor, Department of Engineering Physics, University of Porto

Maria Helena Braga is a Physicist specialized in Solid-State and Materials Science, and has a PhD in Materials Science and Engineering.
She is an Associate Professor and the head of the Engineering Physics Department at FEUP-UPORTO.

From 2008-2011 she has worked in the Los Alamos Neutron Scattering Center, USA, as a Research Scholar and Long Term Visiting Staff Member; and from 2016-2019 she worked as Senior Research Fellow at the University of Texas at Austin, where she brought lithium and sodium ferroelectric glass-electrolytes and new architecture devices developed in Portugal. She also collaborated with Prof. John Goodenough in further developing these and other energy harvesting and storage devices.

:: PAULA GALVÃO

Chief Business and Strategic Relations at INL

Paula Galvão holds a University Degree in Materials Engineering from the University of Minho.
Paula Galvão, working at INL since June 2011, is responsible for activities dealing with coordination of International Projects, technology exploitation, business development, establishing collaborations, INL´s incubator and start-up support program, and to provide advice to researchers on innovation funding schemes.

Paula Galvão started her career at a technology transfer office of a university and over her career she has held several senior and management positions in consulting companies.

Mission 10.000: BATTERIES

October 10th - 11th, 2019 | **INL**, Braga (Portugal)

nanoGateway International Conference

:: KARALEE JARVIS

Research Engineering/Scientist, Univeristy of Texas at Austin

Karalee Jarvis received her PhD in Materials Science and Engineering from Arizona State University.
During her post doctorate at the University of Texas at Austin, she used nanobeam diffraction in STEM mode to collect 4D-STEM data sets for structural characterization of Li oxide materials. She was able to resolve complex structures that even the most sophisticated imaging techniques failed to elucidate. This work produced 8 papers, two of them with over 300 citations each, and provided new insights into the complicated systems of Li oxides.

Jarvis manages a transmission electron microscopy facility at the University of Texas at Austin, where she specializes in Novel Electron Microscopy Techniques for solving complex materials systems.

:: SENENTXU LANCEROS-MÉNDEZ

Scientific Director and Professor, Basque Center for Materials, Applications, and Nanostructures

Senentxu Lanceros-Mendez is graduated in Physics from the University of the Basque Country, Leioa, Spain, and obtained his PhD at the Institute of Physics of the Julius-Maximilians-Universität Würzburg, Germany.

Senentxu is Ikerbasque Professor at the BCMaterials, Basque Center for Materials, Applications and Nanostructures, where he is the Scientific Director. Here in Portugal, he is Associate Professor at the Physics Department of the University of Minho, where also belongs to the Center of Physics.
His work is focused in the area of smart and multifunctional materials for sensors and actuators, energy and biomedical applications. He has over 500 publications in the field, 3 books, 14 book chapters and 10 patents and participated in over 40 European, national and regional R&D projects. Three spin-off companies have been developed from his group.

From 2012 to 2014 he was also Associate Researcher at the INL – International Iberian Nanotechnology Laboratory.

:: MIKEL LASA

CEO, InnoEnergy Iberia

Mikel Lasa holds a PhD on Mechanical Engineering and an MBA (Master of Business Administration).
During most of his career, Mikel has been engaged in bridging innovation, business and education within the energy and automotive sectors.

Since 2010, Mikel Lasa has been CEO of KIC InnoEnergy Iberia and member of the Executive Board.
Before joining KIC InnoEnergy, he worked as head of wind turbine technology division at the engineering company Apia XXI, and as head of analysis and design of wind turbines at the Spanish National Renewable Energy Centre – CENER.

Mission 10.000: BATTERIES

October 10th - 11th, 2019 | **INL**, Braga (Portugal)

nanoGateway International Conference

:: JORGE MAGALHÃES

Senior VP, Vestas

Jorge Magalhães received a Bachelor's degree in Industrial Engineering from the University of Toronto in Canada and a Master's degree in Business Administration from INSEAD in France.

Jorge is the Senior Vice President for Vestas Design Centre Chennai & Porto. In this role, he is in charge of leading the new Design Centre in Porto and the existing Design Centre in Chennai India. Vestas is the world leader in wind energy, with 100 GW of installed wind power worldwide.
Before joining Vestas in 2010, Magalhães held various senior global management positions within the Embedded Communications Computing, business of Emerson and Motorola.

Within his career, Jorge Magalhães enroled various leadership positions with Philips Medical Systems where he oversaw the company's business strategy and development as well as its marketing efforts.

:: LUÍS MAIA

Horizon 2020 National Delegate and Contact Point, GPPQ - Portuguese Framework Promotion Office

Luís Maia holds a Master's Degree in Civil Engineering–Transport Infrastructures and a PhD in Transportation Systems from the University of Porto, in association with the Universities of Lisbon and Coimbra, in the scope of the MIT Portugal programme.
Maia is a Senior Consultant at ANI, where he acts as the Portuguese Delegate and National Contact Point (NCP) for the Horizon 2020 Programme in the areas of Transport, Aviation and Energy.

Luís Maia has a consulting background, having previously worked at the Portuguese consulting company SPI, participating in different national and international projects in the areas of innovation, R&D, entrepreneurship, transportation, strategic planning and regional development. In this scope, Luis developed activities related to the preparation of proposals and project management in the scope of Portuguese and H2020 programmes.

:: ADÉLIO MENDES

Professor, Department of Chemical Engineering, University of Porto

Adélio Mendes is full professor at the Chemical Engineering Department of University of Porto and Coordinator of CEner-FEUP, the Competence Center for Energy of the Faculty of Engineering at the University of Porto, where he received his PhD degree in 1993.

Mendes authored or co-authored more than 370 articles in peer-review international journals, filled 25 families of patents and is the author of a textbook; received an Advanced Research Grant from the ERC on dye-sensitized solar cells.

Adélio Mendes' awards include Air Products Faculty Excellence 2011 Award (USA), Solvay & Hovione Innovation Challenge 2011, Ramos Catarino Innovation Award 2011-2012, ACP Diogo Vasconcelos Applied Research Award 2011, Municipal Medal of Merit by the City of Porto Merit – Gold Degree in 2015, Coimbra University Prize of 2016, Scientific Excellence Award by FEUP and Technology Innovation Award 2017 by the University of Porto.

Mission 10.000: BATTERIES

October 10th - 11th, 2019 | **INL**, Braga (Portugal)

nanoGateway International Conference

:: OSCAR MIGUEL

Director, CIDETEC Energy Storage

Oscar Miguel holds a PhD in Chemistry by the University of the Basque Country (Spain).
Currently he works as Director of the CIDETEC Energy Storage Institute. He has been involved in energy-related industrial research activities for more than 15 years including technology generation, transference and product development. Today he and his team are fully devoted to advanced battery technologies, including Li-ion and Post-Li-ion technologies.

He represents CIDETEC Energy Storage in industrial and research associations like European Battery Alliance (EBA), EGVIA, EARPA, EMIRI or EERA. More recently, he has been appointed Chairman of Working Group #4 on Cell design and Manufacturing within the recently launched ETIP Batteries Europe.
CIDETEC Energy Storage is involved in the core team of BATTERY 2030+, the initiative for a long-term large-scale research program towards the European battery of the future.

:: FÁTIMA MONTEMOR

Professor, Department of Chemical Engineering, Vice-President of Instituto Superior Técnico

M. Fátima Montemor obtained her PhD from the Technical University of Lisbon in 1995.
She is a full Professor at the Department of Chemical Engineering, researcher at CQE and Vice President of Instituto Superior Técnico. Besides that, she is Editor of the Elsevier Journal "Applied Surface Science".

Fátima is also a co-author of more than 250 scientific papers published in International Journals, and more than 300 works presented in international and national Congresses. Actually her H index is 56.

Her scientific interests include the development of functional surface coatings for multipurpose applications in different fields such as surface protection and energy storage.

:: JULIANA RESTREPO

Director-General, AEPIBAL - Industrial Association for Batteries and Energy Storage, BatteryPlat

Juliana Restrepo is a Lawyer and has an MBA (Master of Business Administration) from EADA, and a Master in Business Law from Pompeu Fabra University.

Juliana Restrepo is the General Director of the Secartys group, consisting of five associations: Secartys, Domotys, AEPIBAL, CICAT and Solartys. All of them work in a cluster key, integrating the value chain agents and guiding the improvement of the companies' competitiveness, from the Training, R & D & I, financing and internationalization.

Restrepo has previously held various management positions in the financial sector, and as a consultant for international organizations such as the World Bank and the European Commission.

Interreg España - Portugal

mission 10.000 conference

Mission 10.000: BATTERIES

October 10th - 11th, 2019 | **INL**, Braga (Portugal)

nanoGateway International Conference

:: ENRIQUE ROMERO-CADAVAL

Professor, Power Electric and Electronic Systems R&D Group, University of Extremadura

Enrique Romero-Cadaval received the PhD from the University of Extremadura. He is currently the president of the Power Electronics and Industrial Electronics Jointed Spanish Chapter of the IEEE.

Besides that, he is the Coordinator of the Energy Group for the Intelligent Specialization (RIS3) of the Extremadura Region (Spain), member of the Management Council of the Energy Companies Associations of Extremadura, representing the University of Extremadura, and also the CRO and Co-founder of "Smart Energy Products and Services", a Spin-off Company of the University of Extremadura.

His active research lines are integration of renewable energies, distributed generation, smart grids and electric vehicles. In these areas, he is author of more than 200 contributions listed in the main databases and of many conference contributions and book chapters.

:: THORE SEKKENES

Program director for European Battery Alliance, InnoEnergy Scandinavia AB

Thore Sekkenes has 30 years of experience at management positions in system business related to electric power conversion within ABB and Bombardier Transportation. He has consistently been working with technologies enabling the transformation to sustainability in the power and transport sectors. Thore joined InnoEnergy recently to drive the development of the European battery industry.

:: ANTÓNIO SILVA

Geologist, Lusorecursos

António Silva is graduated in Biology and Geology at the University of Aveiro and holds a Master's degree in Geomaterials and Geological Resources at Universities of Aveiro and Porto. He also concluded his PhD, at this universities, in Geosciences focusing the Petrology, Geochemistry and Metamorphic evolution of a granulite-facies migmatitic terrain.

From then on, he has been in charge of the ongoing geological, mineral processing and metallurgical investigations for the beneficiation and chemical conversion of the lithium-rich aplite-pegmatite ores hosted in the "ROMANO" concession, held by Lusorecursos Portugal Lithium S.A. So far, he has published 5 articles in scientific journals and 26 papers in conference proceedings.

He earned two scholarships to join R&D projects of marine and engineering geology at the Universities of Aveiro and Porto, respectively. Since 2013, he also collaborates with the GeoBioTec R&D Unit.

Mission 10.000: BATTERIES

October 10th - 11th, 2019 | **INL**, Braga (Portugal)

nanoGateway International Conference

:: MARIO SIMÕES

Technology Expert in Energy Storage at EDP Inovação

Mário Simões started his career in industry (2006-2008) working in the energy sector for the Veolia Group in Portugal, after graduating in Electrical Engineering. In 2011, he obtained his PhD degree in Chemistry by the University of Poitiers in France working in electrocatalysis for low temperature fuel cells. Since then he participated in innovation projects in Portugal and Switzerland, having 5 years field experience in lithium-ion batteries, working in R&D at the ETHZ and Belenos Clean Power, a Swatch Group spin-off, prior joining the Energy Storage team at EDP Inovação in 2016.

:: JOAQUÍN VILLAR RODRÍGUEZ

Head of Department, Internationalisation and Forsight, Andalusian Energy Agency

Joaquín Villar Rodríguez is Head of Internationalisation and Prospective Department of the Andalusian Energy Agency, whose mission is to develop the policies of the Andalusian Regional Government aimed at optimising the energy supply of our region, from an economical and environmental point of view, improving the quality of energy services, supporting R+D+I activities in the energy field.

Villar is currently coordinating different international projects and European partnerships on sustainable construction, smart grids, energy efficiency and renewables, EV and energy storage.

His main works carried out in recent years include relevant publications, and participation in several conferences and seminars.

Mission 10.000: BATTERIES

October 10th - 11th, 2019 | **INL**, Braga (Portugal)

nanoGateway International Conference

BRAGA, a lovely city

Braga is a lovely city, one of the oldest in the country, and is teeming with young people who study at its University.

Built more than 2,000 years ago, "Bracara Augusta" was founded by Roman Emperor Augustus. It was located on one of the main Roman roads in the Iberian Peninsula, it was the administrative seat of the Empire, and later given the status of capital of the Roman province of Gallaecia, present-day Galicia, by Emperor Caracalla. The Braga Diocese is the oldest in Portugal and, in the Middle Ages, the city even competed with Santiago de Compostela in power and importance. One of the "Caminos de Santiago" passed through here when this pilgrimage cult grew after the Christian reconquest and the foundation of Portugal.

Braga's Cathedral is also the oldest in the country and was built in the 12th century by the parents of Portugal's first King, D. Henrique, and D. Teresa, who are buried there. Braga is to this day one of the country's main religious centres, having the Holy Week celebrations and the São João festival as the highlights in its liturgical and tourist calendar.

Besides the Tesouro-Museu da Sé (Cathedral Treasure Museum), it is worth visiting the Biscainhos Museum, housed in a Baroque palace, a landmark period in the history of Braga, and the D. Diogo de Sousa Archaeological Museum, since the city also abounds in remains from the Roman era. We suggest a leisurely stroll around the historic centre to visit some of its many churches, admire the houses and historical buildings, such as **Palácio do Raio, Theatro Circo, or Arco da Porta Nova,** and to have a coffee at the emblematic Brasileira with a view of the busy Avenida Central. But Braga is also considered the youngest city in Portugal and, from its contemporary landmarks, the Braga Municipal Stadium stands out, designed by Souto Moura, one of the most prestigious Portuguese architects and a winner of the Pritzker Prize.

The **Theatro Circo** was promoted in 1906 by a group of people from Braga, led by Artur José Soares, José António Veloso, and Cândido Martins. To that date, the city only had the small Teatro São Geraldo. In 1911, the project began to take shape by the hand of the architect João de Moura Coutinho and on April 21, 1915, Theatro Circo was opened, coinciding with a period of great economic and social development in Braga.
Over the decades, the space undergone profound works of rehabilitation, aimed at the conversion of Theatro Circo into a large cultural complex, equipped with the most updated and complete scenic and sound technology, able to meet the needs of contemporary art in its many dimensions.

Praça da República
More info: https://visitbraga.travel/braga

Catedral da Sé de Braga
More info: braga.360portugal.com

Theatro Circo
More info: www.theatrocirco.com/en

Mission 10.000: BATTERIES

October 10th - 11th, 2019 | **INL**, Braga (Portugal)

nanoGateway International Conference

Bom Jesus de Braga
More info: www.youtube.com (Aerial view in 4k)
https://bragacool.com/visitar/bom-jesus-monte
https://www.travelingwithaga.com/how-to-visit-bom-jesus

Here you can download a tour guide and more information about Braga:
https://visitbraga.travel/pub/media/guia/roteiro_braga.pdf

Every visitor to Braga must see the **Bom Jesus Sanctuary,** a city icon, with its monumental stair-case, declared World Heritage by UNESCO in 2019. Amid an expanse of greenery, it offers an excellent panoramic view of the city, as do two other churches nearby: Nossa Senhora do Sameiro Sanctuary, an important place of Marian worship, and Santa Maria da Falperra Church.
Bom Jesus is considered one of the most beautiful sanctuaries in Portugal and it's a reference of Baroque art in Portugal, with its history dating back to the 14th century.
To get there, you can climb the famous staircase to the neoclassical church, with 581 steps, surrounded by magnificent gardens and hotels. Alternatively, you can use the elevator that takes you to the top of the staircase. This elevator, operating since 1882, is unique in the Iberian Peninsula and the oldest in the world still active. The lift is moved by water, by counterweight, with two cabins, which are connected by a cable. The way this elevator works makes it one of the most extraordinary engineering pieces in Portugal.

Moreover, it's also possible to take the car to the top and have a picnic in the magnificent gardens of Bom Jesus and thus enjoy the fresh air of nature and breathtaking scenery. The sunset seen from here gives a whole new sense to the concept of "golden hour".

Over the last few years, the University of Minho and the quality of contemporary architecture have instilled an atmosphere of youthful vibrancy which has brought this ancient city to a level of unexpected modernity.
All these attributes were paramount for Braga to be considered the **Second Best Destination in Europe in 2019** in the contest promoted by **"European Best Destinations".**

Jardim de Santa Bárbara
More info: braga.360portugal.com

Interreg España - Portugal
Fondo Europeo de Desarrollo Regional
Fundo Europeu de Desenvolvimento Regional

nanoGATEWAY

mission 10.000 conference

Mission 10.000: BATTERIES

October 10th - 11th, 2019 | **INL**, Braga (Portugal)

nanoGateway International Conference

Main partners:

Organizer:

Interreg-POCTEP regional Partners:

Interreg España - Portugal

nanoGATEWAY

mission 10000 conference

Batteries

Outubro 10-11, 2019

INL, BRAGA, PORTUGAL

Versão em Português

ISBN 978-989-33-0412-9
Editor: International Iberian Nanotechnology Laboratory
Título: "***Mission 10.000: Batteries***"
Publicação: Vol 2: Livro de Atas de Conferências nanoGateway Mission 10.000;
Autor: INL - Conference Office
Suporte: Eletrónico
Formato: n.d.

Mission 10.000: BATERIAS

Outubro 10-11, 2019 | **INL**, Braga (Portugal)

Conferência Internacional nanoGateway

Mission 10.000: BATERIAS

Bem-vindo à Conferência Internacional nanoGateway Mission 10.000: Baterias

O armazenamento de energia é um componente-chave previsto nos esforços europeus voltados para a descarbonização e transição para as energias sustentáveis.
A eletrificação dos veículos e a democratização do uso de energias renováveis são já um desafio às atuais **tecnologias de baterias** e exigem novas soluções mais eficientes, mais baratas e com menor impacto ambiental.

Atualmente, as baterias de iões de lítio são a tecnologia mais usada em veículos elétricos e no armazenamento de energia eletroquímica. No entanto, assegurar o acesso aos elementos críticos para a produção destas baterias (lítio e cobalto) é um das maiores desafios que a União Europeia (UE) enfrenta.
Sendo difícil a previsão das próximas tecnologias dominantes no mercado das baterias, tem-se unido esforços no sentido de desenvolver uma **estratégia global europeia** voltada para a **investigação** e **inovação** na **indústria das baterias.**

A conferência internacional **Mission 10.000: Baterias** reuniu investigadores, empreendedores e atores da esfera política num debate focado nas **tendências atuais e futuras na indústria das baterias.**
O evento procurou **posicionar a UE** como um elemento-chave no **futuro mercado** de armazenamento de **baterias.**

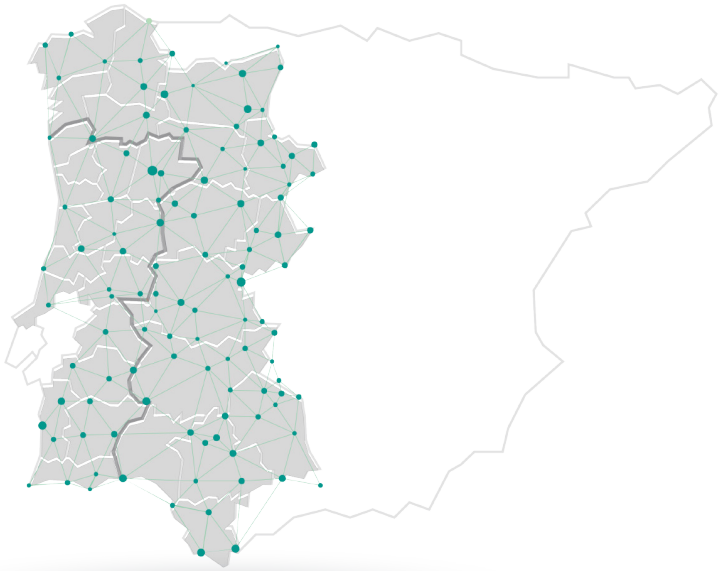
A iniciativa nanoGateway

Nanogateway é um projeto que visa a implementação de uma estratégia multirregional e plano de ação para explorar o potencial da nanotecnologia no fomento do crescimento inteligente, riqueza e qualidade de vida.

O projeto nanoGateway é cofinanciado pelo Programa de Cooperação Interreg V-A Espanha – Portugal (POCTEP) e liderado pelo INL, envolvendo as Agências de Desenvolvimento Regional da área abrangida.

Regiões INTERREG-POCTEP

PORTUGAL
Alentejo Central
Algarve
Alto Alentejo
Alto Minho
Alto Tâmega
Área Metropolitana de Porto
Ave
Baixo Alentejo
Beira Baixa
Beiras e Serra da Estrela
Cávado
Douro
Médio Tejo
Oeste and Alentejo Litoral
Região de Aveiro
Região de Coimbra
Região de Leiria
Tâmega e Sousa
Trás-os-Montes
Viseu Dão-Lafões



ESPAÑA
A Coruña
Ávila
Badajoz
Cáceres
Cádiz
Córdoba
Huelva
León
Lugo
Ourense
Pontevedra
Salamanca
Sevilla
Valladolid
Zamora

Interreg España - Portugal
Fondo Europeo de Desarrollo Regional
Fundo Europeu de Desenvolvimento Regional

nano GATEWAY

mission 10.000 conference

Mission 10.000: BATERIAS

Outubro 10-11, 2019 | **INL**, Braga (Portugal)

Conferência Internacional nanoGateway

Bem-vindos à Conferência Internacional Mission 10.000: Baterias

Encerrando o Ciclo de Conferências Mission 10.000, o INL recebeu o evento Mission 10.000: Batteries, nos dias 10 e 11 de outubro de 2019.

O armazenamento de energia é um componente-chave previsto nos esforços europeus voltados para a descarbonização e transição para as energias sustentáveis.A eletrificação dos veículos e a democratização do uso de energias renováveis são já um desafio às atuais tecnologias de baterias e exigem novas soluções mais eficientes, mais baratas e com menor impacto ambiental.

Atualmente, as baterias de iões de lítio são a tecnologia mais usada em veículos elétricos e no armazenamento de energia eletroquímica. No entanto, assegurar o acesso aos elementos críticos para a produção destas baterias (lítio e cobalto) é um das maiores desafios que a União Europeia enfrenta. Sendo difícil a previsão das próximas tecnologias dominantes no mercado das baterias, tem-se unido esforços no sentido de desenvolver uma estratégia global europeia voltada para a investigação e inovação na indústria das baterias.

Ao longo de dois dias, a Conferência Mission 10.000: Batteries recebeu 140 participantes de todo o mundo que puderem ouvir 10 palestras inspiradoras de oradores mundialmente reconhecidos, participar em duas estimulantes mesas-redondas e assistir a diversas apresentações orais e de posters.

A conferência Mission 10.000: Batteries foi um verdadeiro sucesso, reunindo investigadores, inovadores e autoridades públicas na discussão das tendências atuais e futuras do armazenamento de baterias. As palestras e posters cobriram um largo espetro de tópicos, desde a investigação fundamental à implementação ao nível europeu da indústria das baterias de lítio.

A descarbonização da economia mundial e a transição para a energia sustentável são grandes desafios, mas os participantes da conferência estavam armados com estratégias e soluções. O desenvolvimento dessas tecnologias de armazenamento de energia eletroquímica abrirá portas a milhões de empregos em novas e poderosas indústrias, dará à União Europeia acesso a um segmento maior do mercado mundial de armazenamento de baterias e possibilitará um futuro melhor para as próximas gerações.

Atenciosamente,

Prof, Dr Lars Montelius
Diretor General INL

INL
INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY

Interreg España - Portugal
Fondo Europeo de Desarrollo Regional
Fundo Europeu de Desenvolvimento Regional

nano GATEWAY

mission 10.000 conference

Mission 10.000: BATERIAS

Outubro 10-11, 2019 | **INL**, Braga (Portugal)

Conferência Internacional nanoGateway

Comité Científico

Lifeng Liu, INL – Chair
Paulo Ferreira, INL
Charles Amos, INL
Fátima Montemor, Instituto Superior Técnico
Sónia Eugénio, Instituto Superior Técnico
Oscar Crespo, CIDETEC
Enrique Romero-Cadaval, Universidade da Extremadura
Adélio Mendes, Universidade do Porto
Helena Braga, Universidade do Porto
Senentxu Lanceros-Méndez, Universidade do Minho e BC Materials

Comité de Direção

Lars Montelius, INL – Chair
Sonia Pazos, INL
Luís Caetano, CCDR-Centro
Pedro Figueirido, CCDR-Norte
António Ramos, CCDR-Algarve
Patricia da Costa Félix Bermejo, FUNDECYT Junta de Extremadura
Jose Rivas, Universidade de Santiago de Compostela
Joaquín Villar, Agência de Energia de Andalusia

Comité de Gestão

Lifeng Liu, INL
Paulo Ferreira, INL
Charles Amos, INL
Fátima Montemor, Instituto Superior Técnico
Sónia Eugénio, Instituto Superior Técnico

Mission 10.000: BATERIAS

Outubro 10-11, 2019 | **INL**, Braga (Portugal)

Conferência Internacional nanoGateway

PROGRAMME | October 10th, 2019

8h00 - 9h00 Registration

OPENING SESSION

9h00 **Lars Montelius,** Director-General INL

9h10 **Ricardo Rio,** Mayor of Braga

09h20 **Welcome Message**

:: The European Battery Landscape

Charles Amos, Research Group of Atomic Structure-Composition of Materials (ASCM), INL

:: Competence Centers in Batteries at INL and IST

Lifeng Liu, Group Leader, Nano Materials for Energy storage and conversion, INL

Alberto Adán Más, Researcher, Department of Chemical Engineering, IST

09h50 **Video Interview with the lithium-ion battery pioneer John Goodenough,** Professor, Department of Mechanical Engineering, University of Texas at Austin

MORNING SESSION

INVITED TALK

10h00 ***:: European Battery Alliance - Building the European Battery Industry*** Policy

Thore Sekkenes, Program director for European Battery Alliance, InnoEnergy Scandinavia AB

10h45 Poster Session Presentations - Break

CONTRIBUTED TALKS

11h15 ***:: High Power Blue Lasers, a Disruptive Technology for Battery Welding ::*** **Victor Blanco, Laser 2000 SAS / NUBURU**

11h35 ***:: High-Capacitance Negative Electrode based on Cobalt Phosphide Nanocrystals ::*** **Nan Zhang, INL**

INVITED TALK

11h55 ***:: European Partnership on Advanced Materials for Batteries*** Policy / Science

Joaquín Villar, Head of Department, Internationalisation and Forsight, Andalusian Energy Agency

ROUNDTABLE DISCUSSION

Funding & Collaboration Opportunities

12h20 **Luís Maia**, Horizon 2020 National Delegate and Contact Point, GPPQ - Portuguese Framework Promotion Office

Joaquín Villar, Head of Department, Internationalisation and Forsight, Andalusian Energy Agency

Juliana Restrepo Sintes, Director General, AEPIBAL - Industrial Association for Batteries and Energy Storage | BatteryPlat

Moderator: Paula Galvão, Chief Business and Strategic Relations, INL

INL WORLDWIDE NETWORK & PARTNERS ANNUAL CONFERENCE

Interreg España - Portugal

mission 10.000 conference

Mission 10.000: BATERIAS

Outubro 10-11, 2019 | **INL**, Braga (Portugal)

Conferência Internacional nanoGateway

PROGRAMME | October 10th, 2019

13h20 Networking Lunch — Networking Opportunity

AFTERNOON SESSION

INVITED TALK

14h50 ***:: Fast Charging of Lithium-Ion Batteries*** — Science

Daniel Abraham, Senior Materials Scientist, Argonne National Laboratory

CONTRIBUTED TALKS

15h35 *:: Free-Standing N-Graphene as Conductive Matrix For Ni(OH)2 Based Supercapacitive Electrodes ::* Kush Upadhyay, IST

15h55 *:: Compositional Mapping of LiNixCoyMnzO2 Cathode Materials ::* Cristiana Alves, INL

16h15 Coffee break

INVITED TALK

16h45 ***:: Techology Transfer within the EU Batteries Ecosystem: our experience*** — Innovation / Industry

Oscar Miguel, Director, CIDETEC Energy Storage

INVITED TALK

17h30 ***:: Structural Characterization of Li-ion Battery Materials Using Advanced Electron Microscopy Techniques*** — Science

Karalee Jarvis, Research Engineering/Scientist, Univeristy of Texas at Austin

18h15 INL Tour / Happy Networking Hour

PROGRAMME | October 11th, 2019

8h30 - 9h00 Registration

MORNING SESSION

INVITED TALK

9h00 ***:: Batteries: Industrial Initiatives and Opportunities in Iberia*** — Policy

Mikel Lasa, CEO, InnoEnergy Iberia

CONTRIBUTED TALKS

9h45 *:: How relevant is for Asset Operators to Access Cell Data in Large Scale Stationary Li-ion Battery Projects: the case of 2nd life Batteries ::* Mario Simões, EDP Inovação

10h05 Poster Session Presentations – Break

INL WORLDWIDE NETWORK & PARTNERS ANNUAL CONFERENCE

Interreg España - Portugal

mission 10.000 conference

Mission 10.000: BATERIAS

Outubro 10-11, 2019 | **INL**, Braga (Portugal)

Conferência Internacional nanoGateway

PROGRAMME | October 11th, 2019

INVITED TALK

10h55 — *:: From Thermal Harvesting to Electrical Storage in Li/Na Devices* — Science

Maria Helena Braga, Associate Professor, Department of Engineering Physics, University of Porto

CONTRIBUTED TALKS

11h40 — *:: Nanoconfined Ionic Liquids and Hybrid Ionogels: Tuning the Electrolyte-Electrode Interface ::* **Luis Miguel Varela,** University of Santiago de Compostela

12h00 — *:: Ionic Liquids: Next Generation Electrolytes ::* **Oscar Cabeza,** University of Coruña

INVITED TALK

12h20 — *:: Printed and Solid-state Batteries: Materials, Challenges and Opportunities*

Senentxu Lanceros-Mendez, Scientific Director and Professor, Basque Center for Materials, Applications, and Nanostructures — Technology/Innovation

13h05 — Networking Lunch — Networking Opportunity

AFTERNOON SESSION

INVITED TALK

14h35 — *:: Batteries Interfaces for Renewable Energies and Electric Vehicles* — Technology/Innovation

Enrique Romero-Cadaval, Professor, Power Electric and Electronic Systems R&D Group, University of Extremadura

INVITED TALK

15h20 — *:: Redox Flow Batteries: Present and Future Perspectives* — Science

Adélio Mendes, Professor, Department of Chemical Engineering, University of Porto

16h05 — Coffee break

ROUNDTABLE DISCUSSION

:: Scaling Battery Innovations: now and tomorrow

Opportunities and challenges for the lithium ion battery value chain

16h30

António Silva, Geologist, Lusorecursos

Jorge Magalhães, Senior VP, Vestas

Mario Simões, Technology Expert in Energy Storage, EDP Innovation

Mikel Lasa, CEO, InnoEnergy Iberia

Moderator: Fátima Montemor, IST

17h30 — AWARDS SESSION

Lars Montelius, Director-General INL

17h45 — CLOSING REMARKS

Fátima Montemor, Professor, Department of Chemical Engineering, Vice-President of IST

INL WORLDWIDE NETWORK & PARTNERS ANNUAL CONFERENCE

Interreg España - Portugal

mission 10.000 conference

Mission 10.000: BATERIAS

Outubro 10-11, 2019 | **INL**, Braga (Portugal)

Conferência Internacional nanoGateway

Oradores convidados

:: DANIEL P. ABRAHAM

Senior Materials Scientist, Argonne National Laboratory

Daniel P. Abraham desenvolve investigação em baterias de lítio usadas em veículos elétricos, eletrónica de consumo e armazenamento de energia em grade, no Laboratório Nacional de Argonne. Autor de mais de 130 artigos em revistas especializadas, fez mais de 300 apresentações técnicas em contextos académicos e industriais.

O seu trabalho permite o desenvolvimento de materiais e componentes que melhoram o desempenho, a vida e a segurança das baterias de lítio.
Os seus interesses vão desde a descoberta e desenvolvimento de materiais de elétrodos e eletrólitos a baterias sustentáveis e *eco-friendly*, até à reciclagem de células de iões de lítio existentes para recuperar componentes não renováveis.
Abraham recebeu os prémios "Outstanding Postdoctoral Supervisor Award" e "Pinnacle of Education Award" pelo seu "trabalho excepcional no desenvolvimento da próxima geração de cientistas e engenheiros".

:: HELENA BRAGA

Associate Professor, Department of Engineering Physics, University of Porto

Maria Helena Braga é Física especializada no Estado Sólido e em Ciência dos Materiais e doutorada em Ciência e Engenharia dos Materiais.

Atualmente é Professora Associada e Chefe do Departamento de Engenharia Física da FEUP-UPORTO. Entre 2008 e 2011, trabalhou no Centro de Dispersão de Neutrões de Los Alamos, EUA, como bolseira de investigação e investigadora convidada a longo prazo. De 2016 a 2019, trabalhou como Investigadora Sénior da Universidade do Texas, Austin, para onde levou eletrólitos de vidro ferroelétricos de lítio e sódio, e dispositivos de nova arquitetura desenvolvidos em Portugal. Para além disto, colaborou com o Prof. John Goodenough no desenvolvimento desses e de outros dispositivos de colheita e armazenamento de energia.

:: PAULA GALVÃO

Chief Business and Strategic Relations at INL

Paula Galvão é licenciada em Engenharia de Materiais pela Universidade do Minho.
No INL desde 2011, Paula Galvão é responsável por atividades de coordenação de projetos internacionais, pela exploração de tecnologia, e desenvolvimento de negócios e parcerias. É ainda coordenadora do programa do INL de apoio a start-ups, além de prestar consultoria em financiamento.

Paula Galvão iniciou carreira no gabinete de transferência de tecnologia de uma universidade. Ao longo do seu percurso ocupou vários cargos séniores de gestão em empresas de consultoria, onde adquiriu vasta experiência em gestão e desenvolvimento de relações comerciais com instituições europeias e outras organizações públicas e privadas.

Mission 10.000: BATERIAS

Outubro 10-11, 2019 | **INL**, Braga (Portugal)

Conferência Internacional nanoGateway

:: KARALEE JARVIS

Research Engineering/Scientist, Univeristy of Texas at Austin

Karalee Jarvis completou o doutoramento em Ciência e Engenharia de Materiais pela Arizona State University. Durante o pós-doutoramento na Universidade do Texas, Austin, Jarvis usou a difração de nano-feixe de Sistema de Microscia de Transmissão Eletrónica (STEM) para formar imagens 4D-STEM para a caracterização de materiais de Óxido de Lítio. Consequência do trabalho desenvolvido, Karalee Jarvis foi capaz de definir estruturas complexas, impossíveis de alcançar com as técnicas de imagiologia existentes até à data. Este trabalho produziu 8 artigos, dois deles com mais de 300 citações cada, e trouxe novas ideias sobre os complezos sistemas complicados de Óxidos de Lítio.

Jarvis coordena uma unidade de Microscopia Eletrónica de Transmissão (TEM) na Universidade do Texas, Austin, onde se especializou em Técnicas TEM para resolver sistemas de materiais complexos.

:: SENENTXU LANCEROS-MÉNDEZ

Scientific Director and Professor, Basque Center for Materials, Applications, and Nanostructures

Senentxu Lanceros-Mendez é licenciado em Física pela Universidade do País Basco, Leioa, Espanha, e concluiu o seu doutoramento no Instituto de Física da Julius-Maximilians-Universität Würzburg, na Alemanha.

Senentxu é Professor da Fundação Basca da Ciência, no Centro Basco de Materiais, Aplicações e Nanoestruturas, onde é também Director Científico. Em Portugal, é Professor Associado do Departamento de Física da Universidade do Minho, onde também pertence ao Centro de Física.
O seu trabalho está focado na área de materiais inteligentes e multifuncionais para sensores e atuadores, energia e aplicações biomédicas. Possui mais de 500 publicações na área, 3 livros, 14 capítulos de livros, 10 patentes, e participou em mais de 40 projetos europeus, nacionais e regionais de P&D. A partir do seu grupo foram desenvolvidas três empresas spin-off.

Entre 2012 e 2014, o Físico foi também Investigador Associado no INL - Laboratório Ibérico Internacional de Nanotecnologia.

:: MIKEL LASA

CEO, InnoEnergy Iberia

Mikel Lasa concluiu o doutoramento em Engenharia Mecânica e possui um MBA (Master of Business Administration). Durante grande parte da sua carreira, Mikel dedicou-se à articulação entre inovação, indústria e educação nos setores da energia e automóvel.

Desde 2010 que Mikel Lasa é CEO da KIC InnoEnergy Iberia e membro do Conselho Executivo.
Antes de fazer parte da KIC InnoEnergy, trabalhou como chefe da divisão de tecnologia de turbinas eólicas da Apia XXI, e como chefe de análise e design de turbinas eólicas no Centro Nacional de Energias Renováveis - CENER, em Espanha.

Mission 10.000: BATERIAS

Outubro 10-11, 2019 | **INL**, Braga (Portugal)

Conferência Internacional nanoGateway

:: JORGE MAGALHÃES

Senior VP, Vestas

Jorge Magalhães é licenciado em Engenharia Industrial pela Universidade de Toronto no Canadá, e concluiu o Mestrado em Administração de Empresas pelo INSEAD, em França.

Jorge é Vice-Presidente Sénior do Vestas Design Centre Chennai & Porto, onde é responsável por liderar o novo Design Center no Porto, e o já existente em Chennai, Índia. Vestas é empresa líder em energia eólica, contando com 100 GW de energia eólica instalada em todo o mundo.
Antes de se juntar à Vestas, Magalhães ocupou vários cargos sénior de gestão na Embedded Communications Computing, empresa da Emerson e Motorola.

Ao longo da sua carreira profissional, Jorge assumiu diversas posições de liderança na Philips Medical Systems, onde supervisionou a estratégia e o desenvolvimento de negócios da empresa, bem como os seus esforços de marketing.

:: LUÍS MAIA

Horizon 2020 National Delegate and Contact Point, GPPQ - Portuguese Framework Promotion Office

Luís Maia é mestre em Engenharia Civil - Infraestruturas de Transporte e doutorado em Sistemas de Transporte pela Universidade do Porto, em conjunto com as Universidades de Lisboa e Coimbra, no âmbito do programa MIT Portugal.

Maia é Consultor Sénior da ANI, trabalhando como Representante Português e Ponto de Contacto Nacional para o Programa Horizonte 2020 nas áreas de Transporte, Aviação e Energia.

Luís Maia trabalhou na consultora portuguesa SPI, onde participou em diferentes projetos nacionais e internacionais nas áreas de inovação, I&D, empreendedorismo, transporte, planeamento estratégico e desenvolvimento regional. Desenvolveu atividades relacionadas com a elaboração de propostas e gestão de projetos no âmbito de programas de financiamento nacional e H2020.

:: ADÉLIO MENDES

Professor, Department of Chemical Engineering, University of Porto

Adélio Mendes é professor catedrático no Departamento de Engenharia Química Universidade do Porto e Coordenador do CEner-FEUP, Centro de Competência em Energia da Faculdade de Engenharia da Universidade do Porto, onde realizou o seu doutoramento, em 1993.
É autor ou coautor de mais de 370 artigos em revistas internacionais de grande impacto, submeteu 25 famílias de patentes e é autor de um livro didático; recebeu uma Advanced Research Grant do ERC para o estudo de células solares sensibilizadas por corantes.

Adélio Mendes ganhou vários prémios, nomeadamente o Prémio Air Excellence Faculty 2011 (EUA), Solvay & Hovione Innovation Challenge 2011, Ramos Catarino Innovation Award 2011-2012, ACP Diogo Vasconcelos Applied Research Award 2011, Medalha de Mérito Municipal da Cidade do Porto - Gold Degree em 2015, Prémio Universidade de Coimbra de 2016, Prémio de Excelência Científica pela FEUP e Prémio de Inovação Tecnológica 2017 pela Universidade do Porto.

Interreg España - Portugal

mission 10.000 conference

Mission 10.000: BATERIAS

Outubro 10-11, 2019 | **INL**, Braga (Portugal)

Conferência Internacional nanoGateway

:: OSCAR MIGUEL

Director, CIDETEC Energy Storage

Oscar Miguel é doutorado em Química pela Universidade do País Basco (Espanha).
Atualmente, é Diretor do CIDETEC, Instituto de Armazenamento de Energia.

Está envolvido, há mais de 15 anos, em atividades de investigação industrial relacionadas com energia, incluindo geração de tecnologia, transferência e desenvolvimento de produtos. Hoje, Oscar Miguel e a sua equipa dedicam-se integralmete às tecnologias avançadas de bateria, incluindo as tecnologias de iões Li e Pós-Li.

Representa o CIDETEC Energy Storage em associações industriais e de investigação como a European Battery Alliance (EBA), EGVIA, EARPA, EMIRI ou EERA. Mais recentemente, foi nomeado Presidente do Grupo de Trabalho nº 4 sobre Design e Fabricação de Células nas recém-lançadas ETIP Batteries Europe. CIDETEC Energy Storage faz parte da equipa principal da iniciativa BATTERY 2030+.

:: FÁTIMA MONTEMOR

Professor, Department of Chemical Engineering, Vice-President of Instituto Superior Técnico

M. Fátima Montemor concluiu o seu Doutoramento na Universidade Técnica de Lisboa em 1995.
Atualmente, é Professora Catedrática do Departamento de Engenharia Química, Investigadora do CQE e Vice-Presidente do Instituto Superior Técnico. É ainda editora do Elsevier Journal "Applied Surface Science".

Fátima é co-autora de mais de 250 artigos científicos publicados em revistas internacionais e mais de 300 artigos científicos apresentados em congressos internacionais e nacionais. O seu índice H é 56.

Os seus interesses científicos incluem o desenvolvimento de revestimentos funcionais para aplicações multiuso em diferentes campos como proteção de superfícies e armazenamento de energia.

:: JULIANA RESTREPO

Director-General, AEPIBAL - Industrial Association for Batteries and Energy Storage, BatteryPlat

Juliana Restrepo é advogada, concluiu um MBA (Master of Business Administration) na EADA e é mestre em Direito Empresarial pela Universidade Pompeu Fabra.

Juliana Restrepo é Diretora Geral do grupo Secartys, composto por cinco associações: Secartys, Domotys, AEPIBAL, CICAT e Solartys. O grupo trabalha como um cluster, integrando os agentes da cadeia de valores e orientando o desenvolvimento da competitividade das empresas através de formação, I&D e inovação, financiamento e internacionalização.

Restrepo ocupou já vários cargos de gestão no setor financeiro e consultoria de organizações internacionais como o Banco Mundial e a Comissão Europeia.

Interreg España - Portugal

mission 10.000 conference

Mission 10.000: BATERIAS

Outubro 10-11, 2019 | **INL**, Braga (Portugal)

Conferência Internacional nanoGateway

:: ENRIQUE ROMERO-CADAVAL

Professor, Power Electric and Electronic Systems R&D Group, University of Extremadura

Enrique Romero-Cadaval concluiu o seu doutoramento na Universidade da Extremadura. Atualmente, é presidente do Power Electronics and Industrial Electronics Jointed Spanish Chapter do IEEE.

Romero-Cadaval é Coordenador do Grupo de Energia para a Especialização Inteligente (RIS3) da Região de Extremadura, Espanha, é membro do Conselho de Administração do Cluster de Energia da Extremadura como representante da Universidade da Extremadura, e é também CRO e co-fundador da "Smart Energy Products and Services", empresa Spin-Off da Universidade da Extremadura.

As suas linhas de investigação são a integração de energias renováveis, geração distribuída, redes inteligentes e veículos elétricos. Nessas áreas, ele é autor de mais de 200 contribuições listadas nas principais bases de dados e em conferências, assim como capítulos de livros.

:: THORE SEKKENES

Program director for European Battery Alliance, InnoEnergy Scandinavia AB

Thore Sekkenes conta com 30 anos de experiência em cargos de gestão de negócios de sistemas relacionados com a conversão de energia elétrica nas empresas ABB e Bombardier Transportation.
Tem constantemente trabalhado com tecnologias que permitem a transformação sustentável nos setores de energia e transporte.

Thore Sekkenes juntou-se recentemente à InnoEnergy para impulsionar o desenvolvimento da indústria europeia de baterias.

:: ANTÓNIO SILVA

Geologist, Lusorecursos

António Silva é licenciado em Biologia e Geologia pela Universidade de Aveiro, concluindo o seu Mestrado em Geomateriais e Recursos Geológicos nas Universidade de Aveiro e Porto. Concluiu também o doutoramento em Geociências, focando-se na Petrologia, Geoquímica e Evolução Metamórfica de um Terreno migmatítico de fácies-granulito.

É responsável pelas investigações em desenvolvimento no âmbito do processamento geológico, mineral e metalúrgico para o benefício e conversão química de minerais apito-pegmatitos ricos em lítio, localizados na concessão "ROMANO", realizada pela Lusorecursos Portugal Lithium S.A.
Até agora, publicou 5 artigos em jornais científicos e 26 artigos em atas de conferência.
Ganhou, ainda, duas bolsas de estudo para integrar projetos de Investigação e Desenvolvimento de Geologia Marinha e de Engenharia nas Universidades de Aveiro e Porto.

Interreg España - Portugal

mission 10.000 conference

Mission 10.000: BATERIAS

Outubro 10-11, 2019 | **INL**, Braga (Portugal)

Conferência Internacional nanoGateway

:: MARIO SIMÕES

Technology Expert in Energy Storage at EDP Inovação

Mário Simões iniciou carreira na indústria trabalhando no setor de energia no Grupo Veolia em Portugal entre 2006 e 2008, após concluir a sua licenciatura em Engenharia Eletrónica.

Em 2011, concluiu o doutoramento em Química na Universidade de Poitiers, em França, na área da eletrocatálise para células de combustível de baixa temperatura. Desde então, tem participado em projetos de inovação em Portugal e na Suíça, contando já com 5 anos de experiência na área das baterias de iões de lítio.

Antes de se juntar à equipa de Armazenamento de Baterias na EDP Inovação em 2016, desenvolveu trabalho de I&D no Instituto Federal de Tecnologia de Zurique e na Belenos Clean Power, uma spin-off do Grupo Swatch.

:: JOAQUÍN VILLAR RODRÍGUEZ

Head of Department, Internationalisation and Forsight, Andalusian Energy Agency

Joaquín Villar Rodríguez coordena o Departamento de Internacionalização e Prospetiva da Agência Andaluza de Energia, cuja missão é desenvolver as políticas do Governo Regional da Andaluzia destinadas a otimizar o fornecimento de energia da região do ponto de vista económico e ambiental, e melhorar a qualidade dos serviços energéticos, apoiando as atividades de I&D e inovação no campo energético.

Villar coordena, atualmente, diferentes projetos internacionais e parcerias europeias em construção sustentável, redes inteligentes, eficiência energética e renováveis, veículos elétricos e armazenamento de energia.

Os principais trabalhos realizados nos últimos anos incluem publicações relevantes e participação em várias conferências e seminários.

Mission 10.000: BATERIAS

Outubro 10-11, 2019 | **INL**, Braga (Portugal)

Conferência Internacional nanoGateway

BRAGA

Braga é uma cidade animada, sendo uma das mais antigas de Portugal, e está repleta de jovens que estudam na Universidade aqui instalada.

Construída há mais de 2.000 anos, "Bracara Augusta" foi fundada pelo imperador romano Augusto. Estava localizada numa das principais estradas romanas da Península Ibérica, era a sede administrativa do Império e, posteriormente, recebeu o estatuto de capital da província romana de Gallaecia, atual Galiza, pelo imperador Caracalla. A diocese de Braga é a mais antiga de Portugal. Na Idade Média, a cidade competia com Santiago de Compostela em poder e importância. Um dos "Caminos de Santiago" passou por aqui quando este popular culto de peregrinação cresceu após a Reconquista cristã e a fundação de Portugal.

A **Catedral de Braga** é também a mais antiga do país e foi construída no século XII pelos pais do primeiro rei de Portugal, D. Henrique e D. Teresa, que estão ali sepultados. Braga é, ainda hoje, um dos principais centros religiosos do País, tendo as comemorações da Semana Santa e as Festas Populares de São João como destaques no calendário litúrgico e turístico.

Além do Tesouro-Museu da Sé, vale a pena visitar o Museu dos Biscainhos, instalado num palácio Barroco, um período marcante na história de Braga, bem como o Museu Arqueológico D. Diogo de Sousa, já que, na cidade, também abundam os restos da era romana. Sugerimos um passeio ao redor do centro histórico para visitar algumas das muitas igrejas, admirar as casas e edifícios históricos, como o Palácio do Raio, o Theatro Circo ou o Arco da Porta Nova, e tomar um café na emblemática Brasileira com vista para a movimentada Avenida Central. No entanto, Braga também é considerada a cidade mais jovem de Portugal e, dos seus marcos contemporâneos, destaca-se o Estádio Municipal de Braga, projetado por Souto Moura, um dos arquitetos portugueses mais prestigiados e vencedor do Prémio Pritzker.

O **Theatro Circo** foi promovido em 1906 por um grupo de pessoas de bracarenses, liderado por Artur José Soares, José António Veloso e Cândido Martins. Até essa data, a cidade tinha apenas o pequeno Teatro São Geraldo. Em 1911, o projeto começou a ganhar forma pelas mãos do arquiteto João de Moura Coutinho e a 21 de abril de 1915 foi inaugurado o Theatro Circo, coincidindo com um período de grande desenvolvimento económico e social em Braga. Ao longo das décadas, o espaço passou por profundas obras de reabilitação, para converter o Theatro Circo num grande complexo cultural, equipado com a mais moderna e completa tecnologia cénica e sonora, capaz de atender às necessidades da arte contemporânea nas mais diversas dimensões.

Praça da República
Mais info: https://visitbraga.travel/braga

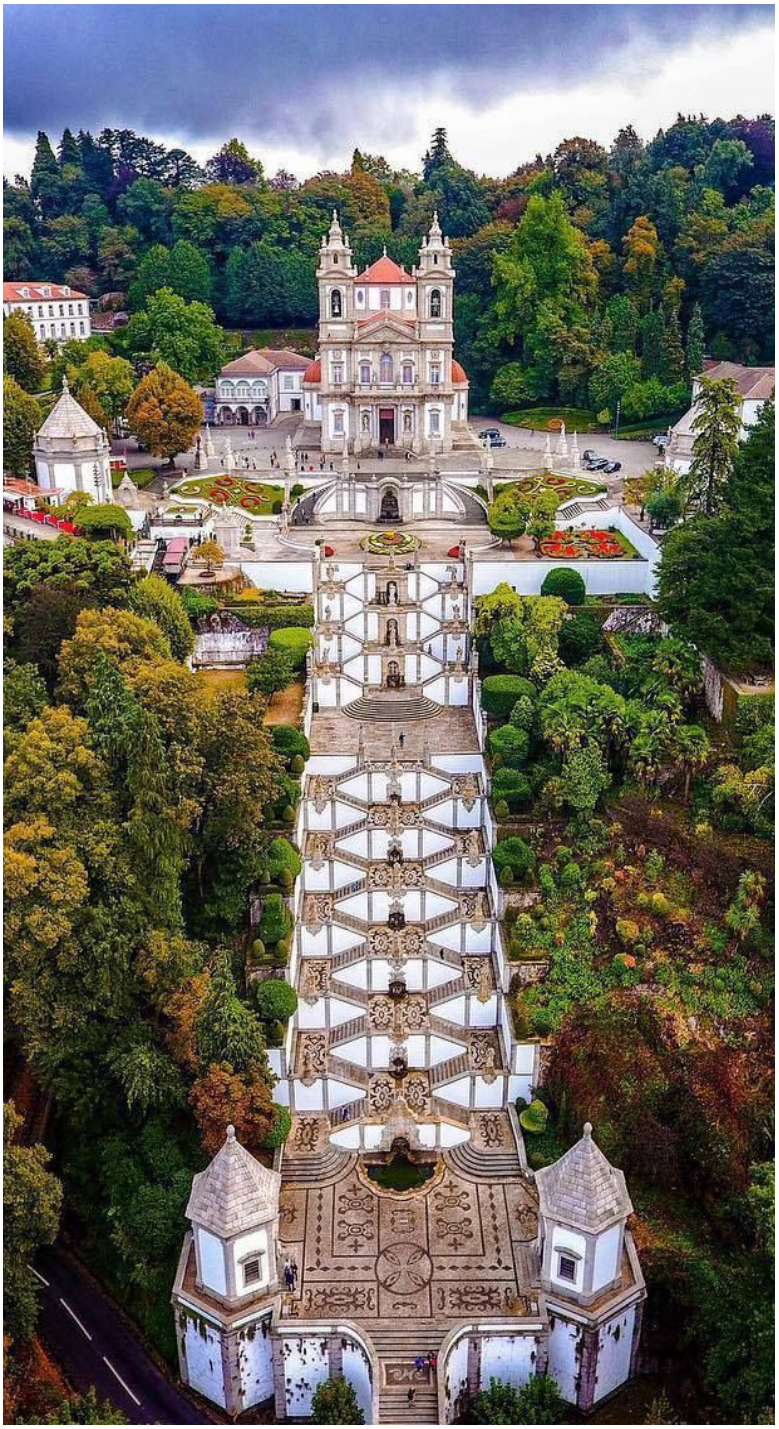
Catedral da Sé de Braga
Mais info: braga.360portugal.com

Theatro Circo
Mais info: www.theatrocirco.com/en

Mission 10.000: BATERIAS

Outubro 10-11, 2019 | **INL**, Braga (Portugal)

Conferência Internacional nanoGateway



Bom Jesus de Braga
Mais info: www.youtube.com (Aerial view in 4k)
https://bragacool.com/visitar/bom-jesus-monte
https://www.travelingwithaga.com/how-to-visit-bom-jesus

Aqui você pode baixar um guia de turismo e mais informações sobre Braga::
https://visitbraga.travel/pub/media/guia/roteiro_braga.pdf

Todo o visitante de Braga deve ir ao **Santuário do Bom Jesus,** um ícone da cidade, com sua escadaria monumental, declarado Património Mundial pela UNESCO em 2019. Situado no meio de uma extensa área de vegetação, oferece uma excelente vista panorâmica da cidade, assim como outras duas igrejas próximas: o Santuário da Nossa Senhora do Sameiro, um importante local de culto mariano, e a Igreja de Santa Maria da Falperra.
O **Bom Jesus** é considerado um dos santuários mais bonitos de Portugal e uma referência da arte barroca no País, com uma história que remonta ao século XIV.
Para chegar ao topo, pode usar-se a famosa escadaria que leva à igreja neoclássica, com 581 degraus, cercada por jardins e hotéis magníficos. Como alternativa, pode optar-se pelo elevador que sobre até ao topo da escada. Este elevador, em operação desde 1882, é único na Península Ibérica e o mais antigo do mundo ainda ativo. O elevador é movido por contrapeso de água, com duas cabines, que são ligadas por um cabo. O funcionamento original deste elevador faz dele uma das peças de engenharia mais extraordinárias de Portugal.
Além disso, também é possível levar o carro até o topo e fazer um piquenique nos magníficos jardins de Bom Jesus e, assim, desfrutar do ar fresco da natureza e de um cenário de tirar o fôlego. O pôr do sol visto daqui dá um novo sentido ao conceito de "hora de ouro".

Nos últimos anos, a Universidade do Minho e a qualidade da arquitetura contemporânea criaram uma atmosfera de vibração juvenil que levou esta cidade antiga a um nível inesperado de modernidade.

Todos esses atributos foram essenciais para Braga ser considerada o **Segundo Melhor Destino da Europa em 2019** no concurso promovido pela "**European Best Destinations**".

Jardim de Santa Bárbara
Mais info: braga.360portugal.com

Interreg España - Portugal
Fondo Europeo de Desarrollo Regional
Fundo Europeu de Desenvolvimento Regional

nanoGATEWAY

mission 10.000 conference

Mission 10.000: BATERIAS

Outubro 10-11, 2019 | **INL**, Braga (Portugal)

Conferência Internacional nanoGateway

Principal Parceiro:

TÉCNICO LISBOA

Organizador:

INL
INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY

Interreg-POCTEP parceiros regionais:

CCDR Algarve

JUNTA DE ANDALUCIA
Agencia de Innovación y Desarrollo de Andalucía IDEA
CONSEJERÍA DE ECONOMÍA, INNOVACIÓN, CIENCIA Y EMPLEO

CCDR ALENTEJO

FUNDECYT PCTEX
un espacio para innovar

ccdrc
comissão de coordenação e desenvolvimento regional do centro

competitividad empresarial ice

Junta de Castilla y León

CCDRn
Comissão de Coordenação e Desenvolvimento Regional do Norte

gain
AXENCIA DE INNOVACIÓN

USC
UNIVERSIDADE DE SANTIAGO DE COMPOSTELA

Interreg
España - Portugal
Fondo Europeo de Desarrollo Regional
Fundo Europeu de Desenvolvimento Regional

nanoGATEWAY

mission 10.000 conference

Interreg España - Portugal

nanoGATEWAY

mission 10000 conference

Batteries

10 y 11 de Octubre, 2019

INL, BRAGA, PORTUGAL

Versión en Español

ISBN 978-989-33-0412-9
Editor: International Iberian Nanotechnology Laboratory
Título: *"Mission 10.000: Batteries"*
Publicación: Vol 2: Libro de Actas de Conferencias nanoGateway Mission 10.000;
Autor: INL - Conference Office
Soporte: Eletrónico
Formato: n.d.

Mission 10.000: BATERÍAS

Octubre, 10 y 11, 2019 | **INL**, Braga (Portugal)

Nanogateway Conferencia Internacional

Mission 10.000: BATERÍAS

Bienvenido a la Conferencia Internacional nano-Gateway Mission 10.000: Baterías

El almacenamiento en baterías representa un elemento clave en la estrategia europea de descarbonización y la transición hacia energías sostenibles. La electrificación de vehículos y la implementación de energías renovables supondrán un desafío para las tecnologías actuales de baterías y exigirán en el futuro **baterías** con mayor densidad de energía, mayores ratios de capacidad, menor coste y menor impacto ambiental.

Actualmente, la tecnología de baterías de Litio es la principal elección para vehículos electricos y almacenamiento electromecánico para la red eléctrica, debido a su densidad energética, ciclo de vida y costes decrecientes. Sin embargo, el acceso a Litio y Cobalto es uno de los mayores problemas para la Unión Europea y una de las principales palancas de innovación en tecnologías de almacenamiento energético en baterías. Debido a la dificultad para predecir la tecnología de baterías dominante en el futuro, la Unión Europea se ha esforzado en desarrollar una **estrategia europea de investigación, innovación y desarrollo industrial de almacenamiento en baterías.**

La conferencia **Mission 10000: Baterías** reunió investigadores, tecnólogos y legisladores para discutir las tendencias actuales y futuras en almacenamiento en baterías para ayudar a posicionar a la Unión Europea como un actor principal en el mercado futuro del almacenamiento en baterías: un mercado multimillonario llamado a crecer rápidamente en el futuro cercano.

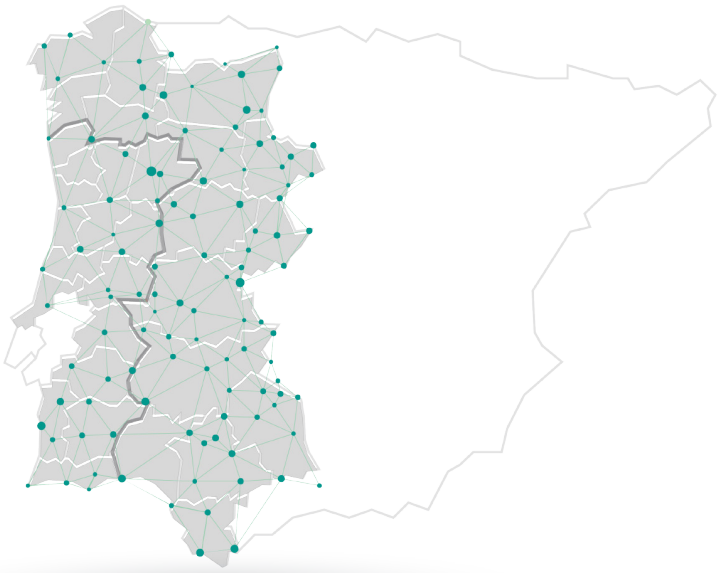
La iniciativa nanoGateway

Nanogateway es un proyecto orientado a implementar una estrategia plurirregional y un plan de acción para desbloquear el potencial de la nanotecnología para generar crecimiento inteligente, riqueza y bienestar.

El proyecto **nanoGateway,** cofinanciado por el Programa de Cooperación Interreg V-A España-Portugal (POCTEP), está liderado por el INL y cuenta con la participación de las Agencias de Desarrollo Regional POCTEP.

REGIONES INTERREG-POCTEP

PORTUGAL
Alentejo Central
Algarve
Alto Alentejo
Alto Minho
Alto Tâmega
Área Metropolitana de Porto
Ave
Baixo Alentejo
Beira Baixa
Beiras e Serra da Estrela
Cávado
Douro
Médio Tejo
Oeste and Alentejo Litoral
Região de Aveiro
Região de Coimbra
Região de Leiria
Tâmega e Sousa
Trás-os-Montes
Viseu Dão-Lafões



ESPAÑA
A Coruña
Ávila
Badajoz
Cáceres
Cádiz
Córdoba
Huelva
León
Lugo
Ourense
Pontevedra
Salamanca
Sevilla
Valladolid
Zamora

Interreg España - Portugal
Fondo Europeo de Desarrollo Regional
Fundo Europeu de Desenvolvimento Regional

nano GATEWAY

mission 10000 conference

Mission 10.000: BATERÍAS

Octubre, 10 y 11, 2019 | **INL**, Braga (Portugal)

Nanogateway Conferencia Internacional

Bienvenidos a la Conferencia Internacional Mission 10.000: Baterías

Cerrando el ciclo de conferencias internacionales Mission 10.000, el INL albergó la conferencia Mission 10.000: Baterías en los días 10 y 11 de octubre de 2019.
El almacenamiento en baterías representa un elemento clave en la estrategia europea de descarbonización y la transición hacia energías sostenibles. La electrificación de vehículos y la implementación de energías renovables supondrán un desafío para las tecnologías actuales de baterías y exigirán en el futuro baterías con mayor densidad de energía, mayores ratios de capacidad, menor coste y menor impacto ambiental.
Actualmente, la tecnología de baterías de Litio es la principal elección para vehículos eléctricos y almacenamiento electromecánico para la red eléctrica, debido a su densidad energética, ciclo de vida y costes decrecientes. Sin embargo, el acceso a Litio y Cobalto es uno de los mayores problemas para la Unión Europea y una de las principales palancas de innovación en tecnologías de almacenamiento energético en baterías. Debido a la dificultad para predecir la tecnología de baterías dominante en el futuro, la Unión Europea se ha esforzado en desarrollar una estrategia europea de investigación, innovación y desarrollo industrial de almacenamiento en baterías.

Durante dos días tuvimos el placer de reunir a 140 participantes de todo el mundo, 10 ponentes de reconocido prestigio internacional nos inspiraron con sus charlas, dos mesas redondas muy estimulantes, y donde investigadores de elevado nivel presentaron sus últimos descubrimientos mediante la presentación de pósters y charlas.
La Conferencia Mission 10.000: Baterías tuvo un éxito rotundo al conectar investigadores, innovadores, y legisladores para debatir sobre las tendencias actuales y futuras del almacenamiento energético. Las charlas y pósters trataron temas desde la investigación básica más allá del Litio, hasta la implantación de la industria de baterías de Litio a nivel europeo. La descarbonización de la economía mundial y la transición a energías sostenibles son retos complejos, pero los participantes de Mission 10.000: Baterías tienen estrategias y soluciones para ello. El desarrollo de estas tecnologías de almacenamiento de energía electromecánica abrirá las puertas a millones de puestos de trabajo en nuevas y poderosas industrias, permitirá que Europa capte una gran cuota del mercado mundial de almacenamiento en baterías, y proporcionará un futuro mejor a las próximas generaciones.

Un cordial saludo,

Prof. Dr Lars Montelius,
DG, INL

INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY

Interreg España - Portugal
Fondo Europeo de Desarrollo Regional
Fundo Europeu de Desenvolvimento Regional

nano GATEWAY

mission 10.000 conference

Mission 10.000: BATERÍAS

Octubre, 10 y 11, 2019 | **INL**, Braga (Portugal)

Nanogateway Conferencia Internacional

Comité Científico

Lifeng Liu, INL – Chair
Paulo Ferreira, INL
Charles Amos, INL
Fátima Montemor, Instituto Superior Técnico
Sónia Eugénio, Instituto Superior Técnico
Oscar Crespo, CIDETEC
Enrique Romero-Cadaval, Universidad de Extremadura
Adélio Mendes, Universidad de Porto
Helena Braga, Universidad de Porto
Senentxu Lanceros-Méndez, Universidad de Minho e BC Materials

Comité de Dirección

Lars Montelius, INL – Chair
Sonia Pazos, INL
Luís Caetano, CCDR-Centro
Pedro Figueirido, CCDR-Norte
António Ramos, CCDR-Algarve
Patricia da Costa Félix Bermejo, FUNDECYT Junta de Extremadura
Jose Rivas, Universidad de Santiago de Compostela
Joaquín Villar, Agencia Andaluza de la Energía

Comité Organizador

Lifeng Liu, INL
Paulo Ferreira, INL
Charles Amos, INL
Fátima Montemor, Instituto Superior Técnico
Sónia Eugénio, Instituto Superior Técnico

Interreg España - Portugal
Fondo Europeo de Desarrollo Regional
Fundo Europeu de Desenvolvimento Regional

nano GATEWAY

mission 10.000 conference

Mission 10.000: BATERÍAS

Octubre, 10 y 11, 2019 | **INL**, Braga (Portugal)

Nanogateway Conferencia Internacional

PROGRAMME | October 10th, 2019

8h00 - 9h00 Registration

OPENING SESSION

9h00 **Lars Montelius,** Director-General INL

9h10 **Ricardo Rio,** Mayor of Braga

09h20 **Welcome Message**

:: The European Battery Landscape

Charles Amos, Research Group of Atomic Structure-Composition of Materials (ASCM), INL

:: Competence Centers in Batteries at INL and IST

Lifeng Liu, Group Leader, Nano Materials for Energy storage and conversion, INL

Alberto Adán Más, Researcher, Department of Chemical Engineering, IST

09h50 **Video Interview with the lithium-ion battery pioneer John Goodenough,** Professor, Department of Mechanical Engineering, University of Texas at Austin

MORNING SESSION

INVITED TALK

10h00 ***:: European Battery Alliance - Building the European Battery Industry*** Policy

Thore Sekkenes, Program director for European Battery Alliance, InnoEnergy Scandinavia AB

10h45 Poster Session Presentations - Break

CONTRIBUTED TALKS

11h15 ***:: High Power Blue Lasers, a Disruptive Technology for Battery Welding ::*** **Victor Blanco,** Laser 2000 SAS / NUBURU

11h35 ***:: High-Capacitance Negative Electrode based on Cobalt Phosphide Nanocrystals ::*** **Nan Zhang,** INL

INVITED TALK

11h55 ***:: European Partnership on Advanced Materials for Batteries*** Policy / Science

Joaquín Villar, Head of Department, Internationalisation and Forsight, Andalusian Energy Agency

ROUNDTABLE DISCUSSION

Funding & Collaboration Opportunities

12h20 **Luís Maia**, Horizon 2020 National Delegate and Contact Point, GPPQ - Portuguese Framework Promotion Office

Joaquín Villar, Head of Department, Internationalisation and Forsight, Andalusian Energy Agency

Juliana Restrepo Sintes, Director General, AEPIBAL - Industrial Association for Batteries and Energy Storage | BatteryPlat

Moderator: Paula Galvão, Chief Business and Strategic Relations, INL

INL WORLDWIDE NETWORK & PARTNERS ANNUAL CONFERENCE

Interreg España - Portugal

nano GATEWAY

mission 10.000 conference

Mission 10.000: BATERÍAS

Octubre, 10 y 11, 2019 | **INL**, Braga (Portugal)

Nanogateway Conferencia Internacional

PROGRAMME | October 10th, 2019

13h20 Networking Lunch — Networking Opportunity

AFTERNOON SESSION

INVITED TALK

14h50 ***:: Fast Charging of Lithium-Ion Batteries*** — Science

Daniel Abraham, Senior Materials Scientist, Argonne National Laboratory

CONTRIBUTED TALKS

15h35 *:: Free-Standing N-Graphene as Conductive Matrix For Ni(OH)2 Based Supercapacitive Electrodes ::* Kush Upadhyay, IST

15h55 *:: Compositional Mapping of LiNixCoyMnzO2 Cathode Materials ::* Cristiana Alves, INL

16h15 Coffee break

INVITED TALK

16h45 ***:: Techology Transfer within the EU Batteries Ecosystem: our experience*** — Innovation / Industry

Oscar Miguel, Director, CIDETEC Energy Storage

INVITED TALK

17h30 ***:: Structural Characterization of Li-ion Battery Materials Using Advanced Electron Microscopy Techniques*** — Science

Karalee Jarvis, Research Engineering/Scientist, Univeristy of Texas at Austin

18h15 INL Tour / Happy Networking Hour

PROGRAMME | October 11th, 2019

8h30 - 9h00 Registration

MORNING SESSION

INVITED TALK

9h00 ***:: Batteries: Industrial Initiatives and Opportunities in Iberia*** — Policy

Mikel Lasa, CEO, InnoEnergy Iberia

CONTRIBUTED TALKS

9h45 *:: How relevant is for Asset Operators to Access Cell Data in Large Scale Stationary Li-ion Battery Projects: the case of 2nd life Batteries ::* Mario Simões, EDP Inovação

10h05 Poster Session Presentations – Break

INL WORLDWIDE NETWORK & PARTNERS ANNUAL CONFERENCE

Interreg España - Portugal

mission 10.000 conference

Mission 10.000: BATERÍAS

Octubre, 10 y 11, 2019 | **INL**, Braga (Portugal)

Nanogateway Conferencia Internacional

PROGRAMME | October 11th, 2019

INVITED TALK

10h55 — ***:: From Thermal Harvesting to Electrical Storage in Li/Na Devices*** — Science

Maria Helena Braga, Associate Professor, Department of Engineering Physics, University of Porto

CONTRIBUTED TALKS

11h40 — ***:: Nanoconfined Ionic Liquids and Hybrid Ionogels: Tuning the Electrolyte-Electrode Interface ::*** **Luis Miguel Varela,** University of Santiago de Compostela

12h00 — ***:: Ionic Liquids: Next Generation Electrolytes ::*** **Oscar Cabeza,** University of Coruña

INVITED TALK

12h20 — ***:: Printed and Solid-state Batteries: Materials, Challenges and Opportunities***

Senentxu Lanceros-Mendez, Scientific Director and Professor, Basque Center for Materials, Applications, and Nanostructures — Technology/Innovation

13h05 — Networking Lunch — Networking Opportunity

AFTERNOON SESSION

INVITED TALK

14h35 — ***:: Batteries Interfaces for Renewable Energies and Electric Vehicles*** — Technology/Innovation

Enrique Romero-Cadaval, Professor, Power Electric and Electronic Systems R&D Group, University of Extremadura

INVITED TALK

15h20 — ***:: Redox Flow Batteries: Present and Future Perspectives*** — Science

Adélio Mendes, Professor, Department of Chemical Engineering, University of Porto

16h05 — Coffee break

ROUNDTABLE DISCUSSION

:: Scaling Battery Innovations: now and tomorrow
Opportunities and challenges for the lithium ion battery value chain

16h30

António Silva, Geologist, Lusorecursos
Jorge Magalhães, Senior VP, Vestas
Mario Simões, Technology Expert in Energy Storage, EDP Innovation
Mikel Lasa, CEO, InnoEnergy Iberia

Moderator: Fátima Montemor, IST

17h30 — **AWARDS SESSION**

Lars Montelius, Director-General INL

17h45 — **CLOSING REMARKS**

Fátima Montemor, Professor, Department of Chemical Engineering, Vice-President of IST

INL WORLDWIDE NETWORK & PARTNERS ANNUAL CONFERENCE

Interreg España - Portugal — Fondo Europeo de Desarrollo Regional / Fundo Europeu de Desenvolvimento Regional

nano GATEWAY

mission 10.000 conference

Mission 10.000: BATERÍAS

Octubre, 10 y 11, 2019 | **INL**, Braga (Portugal)

Nanogateway Conferencia Internacional

Ponentes Invitados

:: DANIEL P. ABRAHAM

Senior Materials Scientist, Argonne National Laboratory

Daniel P. Abraham investiga sobre baterias de litio utilizadas en vehículos eléctricos, electrónica de consumo y almacenamiento de energía de red en el Argonne National Laboratory. Es autor de más de 130 artículos en revistas especializadas y ha hecho más de 300 presentaciones técnicas para público general, académico e industrial.

Su trabajo permite el desarrollo de materiales y componentes que mejoran el rendimiento de la batería de litio, su vida útil y seguridad.
Sus intereses abarcan desde el descubrimiento y desarrollo de electrodos y materiales electrolíticos para baterías sostenibles y ecológicas, hasta el reciclaje de células existentes de iones de litio para recuperar componentes no renovables.
Abraham ha recibido los premios "Outstanding Postdoctoral Supervisor Award" y "Pinnacle of Education Award" por su "trabajo excepcional en el desarrollo de la próxima generación de científicos e ingenieros".

:: HELENA BRAGA

Associate Professor, Department of Engineering Physics, University of Porto

Maria Helena Braga es Física especializada en el Estado Sólido y Ciencias de los Materiales y tiene un Doctorado en Ciencia e Ingeniería de los Materiales.
Actualmente, es profesora asociada y jefe del departamento de Ingeniería Física de la FEUP-UPORTO.

De 2008 a 2011, trabajó en el Centro de Dispersión de Neutrones de Los Alamos, en Estados Unidos, como becaria de investigación y miembro del personal visitante a largo plazo. Entre 2016 y 2019, trabajó como Investigadora senior en la Universidad de Texas en Austin, a la cual aportó electrolitos de vidrio ferroeléctricos de sodio y lítio, y dispositivos de nueva arquitectura desarrollados en Portugal. Además de esto, colaboró con el profesor John Goodenough en el desarrollo de estos y otros dispositivos de recolección y almacenamiento de energía.

:: PAULA GALVÃO

Chief Business and Strategic Relations at INL

Paula Galvão cursó estudios en Ingeniería de Materiales por la Universidad do Minho.

En INL desde junio de 2011, es responsable de actividades relacionadas con la coordinación de proyectos internacionales, explotación de tecnología, desarrollo de negocios, establecimiento de colaboraciones, incubadora de INL y el programa de apoyo a las start-ups, así como asesorar a los investigadores en cuanto a esquemas de financiación de la innovación.
Paula Galvão empezó su carrera en una oficina de transferencia de tecnología de una universidad y a lo largo de su carrera ha ocupado varios puestos de alta dirección y gerencia en empresas de Consultoría.

Interreg España - Portugal

mission 10.000 conference

Mission 10.000: BATERÍAS

Octubre, 10 y 11, 2019 | **INL**, Braga (Portugal)

Nanogateway Conferencia Internacional

:: KARALEE JARVIS

Research Engineering/Scientist, Univeristy of Texas at Austin

Jarvis terminó su doctorado en Ciencia e Ingeniería de Materiales de la Arizona State University.
Durante el post doctorado en la Universidad de Texas, Austin, Jarvis utilizó la difracción de nano-haz del Sistema de Microscopía de Transmisión Electrónica (STEM) para formar imágenes 4D-STEM para la caracterización de materiales de óxido de litio. Como resultado del trabajo realizado, Karalee Jarvis pudo definir estructuras complejas que incluso las técnicas de imagen más sofisticadas no lograron dilucidar. Este trabajo ha producido 8 artículos, dos de ellos con más de 300 citas cada uno, y aportó nuevos conocimientos sobre los complicados sistemas de óxidos de litio.

:: SENENTXU LANCEROS-MÉNDEZ

Scientific Director and Professor, Basque Center for Materials, Applications, and Nanostructures

Senentxu Lanceros-Méndez se graduó en Física en la Universidad del País Vasco, Leioa, España y obtuvo su doctorado en el Instituto de Física de Julius-Maximilians-Universität Würzburg, Alemania.

Sanentxu es Profesor de la Fundación Vasca de la Ciencia, en el Centro Vasco de Materiales, Aplicaciones y Nanoestructuras, donde también es Director Científico. En Portugal, es Profesor asociado en el Departamento de Física de la Universidad de Minho y pertenece también al Centro de Física.
Su trabajo se centra en materiales inteligentes y multifuncionales para sensores y actuadores, energía y aplicaciones biomédicas. Tiene más de 500 publicaciones en ese campo, 3 libros, 14 capítulos de libros, 10 patentes y ha participado en más de 40 proyectos de I&D europeos, nacionales y regionales. A partir de su grupo se desarrollaran tres spin-offs.

Entre 2012 y 2014, el físico también fue investigador asociado en INL - Laboratorio Ibérico Internacional de Nanotecnología.

:: MIKEL LASA

CEO, InnoEnergy Iberia

Mikel Lasa tiene un doctorado en Ingeniería Mecánica y un MBA (Master of Business Administration).
Durante la mayor parte de su carrera, Mikel se ha dedicado a conectar la innovación, la industria y la educación dentro de los sectores de energía y automoción.

Desde 2010, Mikel Lasa es CEO de KIC InnoEnergy Iberia y miembro del Consejo Ejecutivo.
Antes de unirse a KIC InnoEnergy, trabajó como jefe de división de tecnología de turbinas eólicas en la empresa de ingeniería Apia XXI, y como jefe de análisis y diseño de turbinas eólicas en el Centro Nacional de Energías Renovables - CENER.

Mission 10.000: BATERÍAS

Octubre, 10 y 11, 2019 | **INL**, Braga (Portugal)

Nanogateway Conferencia Internacional

:: JORGE MAGALHÃES

Senior VP, Vestas

Jorge Magalhães es licenciado en Ingeniería industrial de la Universidad de Toronto en Canadá y completó un Máster en Administración de Empresas por INSEAD en Francia.

Jorge es Vicepresidente Sénior del Vestas Design Centre Chennai & Porto. En esta función es responsable de liderar el nuevo Centro de Diseño en Porto y el ya operacional en Chennai, India. Vestas es la compañía líder de energía eólica con 100 GW de energía eólica instalada en todo el mundo.
Antes de ingresar en Vespas, Magalhães ocupó varios puestos de gerencia global senior en Embedded Communications Computing,empresa de Emerson y Motorola.

A lo largo de su carrera profesional, Jorge ha ocupado diversos puestos de liderazgo en Philips Medical Systems, donde supervisó la estrategia y el desarrollo comercial de la empresa, así como sus esfuerzos de marketing.

:: LUÍS MAIA

Horizon 2020 National Delegate and Contact Point, GPPQ - Portuguese Framework Promotion Office

Luís Maia completó el Máster en Ingeniería Civil - Infraestructura de Transporte y un doctorado en Sistemas de Transporte en la Universidad de Porto, junto con las Universidades de Lisboa y Coimbra, bajo el programa MIT Portugal.
Maia es Consultor Senior de ANI y trabaja como Representante Portugués y Punto de Contacto Nacional del Programa Horizonte 2020 en las áreas de Transporte, Aviación y Energía.

Luís Maia trabajó en la consultora portuguesa SPI, donde participó en diferentes proyectos nacionales e internacionales en las áreas de innovación, I+D, emprendimiento, transporte, planificación estratégica y desarrollo regional. Ha desarrollado actividades de gestión de proyectos y propuestas relacionadas con los programas de financiación nacionales y H2020.

:: ADÉLIO MENDES

Professor, Department of Chemical Engineering, University of Porto

Adélio Mendes es profesor titular en el Departamento de Ingeniería Química e Coordinador de CEner-FEUP, el Centro de Competencia de Energía de la Facultad de Ingeniería de la Universidad de Oporto, donde recibió su doctorado, en 1993.

Es autor o coautor de más de 370 artículos en revistas internacionales de alto impacto, presentó 25 familias de patentes y fue autor de un libro de texto; recibió una "Advanced Research Grant" del ERC para el estudio de células solares sensibilizadas con colorantes.

Los premios ganados por Mendes incluyen: Premio Air Products Faculty Excellence 2011 (EE. UU.), Solvay & Hovione Innovation Challenge 2011, Ramos Catarino Innovation Award 2011-2012, ACP Diogo Vasconcelos Applied Research Award 2011, Medalla de Mérito por la Ciudad de Porto - Título de Oro en 2015, Premio de la Universidad de Coimbra de 2016, Premio a la Excelencia Científica por FEUP y Premio a la Innovación Tecnológica 2017 por la Universidad de Oporto.

Interreg España - Portugal

mission 10.000 conference

Mission 10.000: BATERÍAS

Octubre, 10 y 11, 2019 | **INL**, Braga (Portugal)

Nanogateway Conferencia Internacional

:: OSCAR MIGUEL

Director, CIDETEC Energy Storage

Oscar Miguel es doctorado en Química por la Universidad del País Vasco (España).
Actualmente es Director de CIDETEC.

Lleva más de 15 años involucrado en actividades de investigación industrial relacionadas con la energía, como la generación de tecnología, la transferencia y el desarrollo de productos. Hoy, Oscar Miguel y su equipo están totalmente dedicados a las tecnologías avanzadas de batería, incluidas las tecnologías de iones de litio y post-litio. Representa a CIDETEC Energy Storage en asociaciones industriales y de investigación como la European Battery Alliance (EBA), EGVIA, EARPA, EMIRI o EERA. Más recientemente, fue nombrado Presidente del Grupo de trabajo 4 sobre diseño y fabricación de células en el recientemente lanzado ETIP Batteries Europe.

CIDETEC Energy Storage está involucrada en el equipo central de BATTERY 2030+, una iniciativa de un programa de investigación a gran escala y largo plazo para la futura batería europea.

:: FÁTIMA MONTEMOR

Professor, Department of Chemical Engineering, Vice-President of Instituto Superior Técnico

M. Fátima Montemor completó su doctorado en la UNIVERSIDAD TÉCNICA DE LISBOA en 1998.
Actualmente, es profesora titular en el Departamento de Ingeniería Química, Investigadora de CQE y Vicepresidenta del Instituto Superior Técnico. Es también editora del Elsevier Journal "Applied Surface Science".

Fátima es coautora de más de 250 artículos científicos publicados en revistas internacionales y más de 300 artículos científicos presentados en congresos internacionales y nacionales. Su índice H es 56.

Sus intereses científicos incluyen el desarrollo de recubrimientos funcionales de superficie para múltiples aplicaciones en diferentes ramos como la protección de superficies y el almacenamiento de energía.

:: JULIANA RESTREPO

Director-General, AEPIBAL - Industrial Association for Batteries and Energy Storage, BatteryPlat

Juliana Restrepo es abogada, completó un MBA (Master of Business Administration) en EADA y un master en Derecho Comercial de la Universidad Pompeu Fabra.

Juliana Restepo es Directora General del grupo Secartys, compuesto por cinco asociaciones: Secartys, Domotys, AEPIBAL, CICAT y Solartys. El grupo funciona como un clúster, integrando los agentes de la cadena de valor y guiando el desarrollo de la competitividad de las empresas a través de la capacitación, I + D e innovación, financiación e internacionalización.

Restrepo ha ocupado diversos cargos directivos en el sector financiero y consultoría de organizaciones internacionales como el Banco Mundial y la Comisión Europea.

Mission 10.000: BATERÍAS

Octubre, 10 y 11, 2019 | **INL**, Braga (Portugal)

Nanogateway Conferencia Internacional

:: ENRIQUE ROMERO-CADAVAL

Professor, Power Electric and Electronic Systems R&D Group, University of Extremadura

Enrique Romero-Cadaval completó su doctorado en la Universidad de Extremadura. Actualmente es presidente del Power Electronics y Industrial Electronics Jointed Spanish Chapter de IEEE.

Romero-Cadaval es Coordinador del Grupo de Energía para la Especialización Inteligente (RIS3) de la Región de Extremadura, es miembro del Consejo de Administración del Clúster de la Energía de Extremadura como representante de la Universidad de Extremadura, y también es CRO y co- fundador de "Smart Energy Products and Services", empresa spin-off de la Universidad de Extremadura.

Sus líneas de investigación son la integración de energías renovables, generación distribuida, redes inteligentes y vehículos eléctricos. En estas áreas, es autor de más de 200 contribuciones que figuran en las principales bases de datos y conferencias, así como en capítulos de libros

:: THORE SEKKENES

Program director for European Battery Alliance, InnoEnergy Scandinavia AB

Sekkenes cuenta ya con 30 años de experiencia en puestos de gestión empresarial para sistemas de conversión de energía en ABB y Bombardier Transportation.
Durante estos años, ha trabajado con tecnologías que permiten una transformación sostenible en los sectores de energía y transporte.
Thore Sekkenes se unió recientemente a InnoEnergy para impulsar el desarrollo de la industria europea de baterías.

:: ANTÓNIO SILVA

Geologist, Lusorecursos

António Silva es graduado en Biología y Geología por la Universidad de Aveiro, y finalizó un Máster en Geomateriales y Recursos Geológicos en las Universidades de Aveiro y Oporto. Para completar su formación, concluyó, en las mismas Universidades, su doctorado en Geociencias, centrándose en la Petrología, Geoquímica y Evolución metamórfica de un terreno migmatítico de fácies granulito.

Desde entonces, ha estado a cargo de las investigaciones geológicas, de procesamiento de minerales y metalúrgicas en curso para el beneficio y la conversión química de los minerales de aplita-pegmatita ricos en litio que están localizados en la concesión "ROMANO", realizada por Lusorecursos Portugal Lithium S.A. Hasta ahora ha publicado 5 artículos en revistas científicas y 26 artículos en actas de congresos.

Obtuvo dos becas para unirse a proyectos de I&D de Geología Marina y de Ingeniería en las Universidades de Aveiro y Oporto, respectivamente. Desde 2013, colabora con la Unidad de I&D GeoBioTec.

Mission 10.000: BATERÍAS

Octubre, 10 y 11, 2019 | **INL**, Braga (Portugal)

Nanogateway Conferencia Internacional

:: MARIO SIMÕES

Technology Expert in Energy Storage at EDP Inovação

Mário Simões comenzó su carrera en la industria (2006-2008), trabajando en el sector energético con el Grupo Veolia en Portugal, después de terminar su graduación en Ingeniería Electrónica. En 2011, completó su doctorado en Química, en la Universidad de Poitiers, Francia, investigando electrocatálisis para células de combustible de baja temperatura. Desde entonces, ha participado en proyectos de innovación en Portugal y Suiza, com ya 5 años de experiencia en baterías de iones de litio. Antes de ingresar el equipo de Almacenamiento de Baterías de EDP Inovación en 2016, desarrolló trabajos de I&D en el Instituto Federal de Tecnología de Zúrich y en Belenos Clean Power, una spin-off del Grupo Swatch.

:: JOAQUÍN VILLAR RODRÍGUEZ

Head of Department, Internationalisation and Forsight, Andalusian Energy Agency

Joaquín Villar Rodríguez coordina el Departamento de Internacionalización y Prospección de la Agencia Andaluza de la Energía, cuya misión es desarrollar políticas del Gobierno regional andaluz destinadas a optimizar el suministro de energía de la región desde un punto de vista económico y ambiental, y mejorar la calidad de los servicios mediante el apoyo a actividades de I+D+I en el campo de la energía. Actualmente, Villar coordina diferentes proyectos internacionales y asociaciones europeas en construcción sostenible, redes inteligentes, eficiencia energética y renovable, vehículos eléctricos y almacenamiento de energía.

Las principales obras de Joaquín Villar Rodríguez en los últimos años incluyen publicaciones relevantes y participación en varias conferencias y seminarios.

Mission 10.000: BATERÍAS

Octubre, 10 y 11, 2019 | **INL**, Braga (Portugal)

Nanogateway Conferencia Internacional

BRAGA

Braga es una ciudad animada, una de las más antiguas de Portugal, y está llena de jóvenes que estudian en su Universidad.

Construida hace más de 2.000 años, "Bracara Augusta" fue fundada por el emperador romano Augusto. Estaba ubicada en una de las principales vías romanas de la Península Ibérica, era la sede administrativa del Imperio, y más tarde se le otorgó el estatuto de capital de la provincia romana de Gallaecia, actual Galicia, por el emperador Caracalla. La diócesis de Braga es la más antigua de Portugal y, en la Edad Media, la ciudad incluso compitió con Santiago de Compostela en poder e importancia. Uno de los "Caminos de Santiago" pasó por aquí cuando este culto de peregrinación creció después de la reconquista cristiana y la fundación de Portugal.

La **catedral de Braga** también es la más antigua del país y fue construida en el siglo XII por los padres del primer rey de Portugal, D. Henrique y D. Teresa, que están enterrados allí. Braga es hoy en día uno de los principales centros religiosos del país, teniendo las celebraciones de la Semana Santa y el festival de São João como lo más destacado en su calendario litúrgico y turístico.
Además del Tesouro-Museu da Sé (Museo del Tesoro de la Catedral), vale la pena visitar el Museo Biscainhos, ubicado en un palacio barroco, un período histórico en la historia de Braga, y el Museo Arqueológico D. Diogo de Sousa, ya que la ciudad también abunda en restos de la época romana. Sugerimos un paseo tranquilo por el centro histórico para visitar algunas de sus numerosas iglesias, admirar las casas y edificios históricos, como el Palácio do Raio, el Theatro Circo o el Arco da Porta Nova, y tomar un café en la emblemática Brasileira con un vista de la concurrida Avenida Central. Pero Braga también es considerada la ciudad más joven de Portugal y, desde sus puntos de referencia contemporáneos, se destaca el Estadio Municipal de Braga, diseñado por Souto Moura, uno de los arquitectos portugueses más prestigiosos y ganador del Premio Pritzker.

Theatro Circo fue promovido en 1906 por un grupo de personas de Braga, dirigido por Artur José Soares, José António Veloso y Cândido Martins. Hasta esa fecha, la ciudad solo tenía el pequeño Teatro São Geraldo. En 1911, el proyecto comenzó a tomar forma por la mano del arquitecto João de Moura Coutinho y el 21 de abril de 1915 se inauguró Theatro Circo, coincidiendo con un período de gran desarrollo económico y social en Braga. A lo largo de las décadas, el espacio sufrió profundos trabajos de rehabilitación, destinados a la conversión de Theatro Circo en un gran complejo cultural, equipado con la tecnología escénica y sonora más actualizada y completa, capaz de satis-

Praça da República
Más info: https://visitbraga.travel/braga

Catedral da Sé de Braga
Más info: braga.360portugal.com

Theatro Circo
Más info: www.theatrocirco.com/en

Mission 10.000: BATERÍAS

Octubre, 10 y 11, 2019 | **INL**, Braga (Portugal)

Nanogateway Conferencia Internacional

Bom Jesus de Braga

Más info: www.youtube.com (Aerial view in 4k)
https://bragacool.com/visitar/bom-jesus-monte
https://www.travelingwithaga.com/how-to-visit-bom-jesus

Aquí puedes descargar una tour guide con más información sobre Braga:
https://visitbraga.travel/pub/media/guia/roteiro_braga.pdf

facer las necesidades del arte contemporáneo en sus muchas dimensiones.

Todos los visitantes de Braga deben ir al **Santuario de Bom Jesus,** un cono de la ciudad, con su monumental escalera, declarado Patrimonio de la Humanidad por la UNESCO en 2019. En medio de una extensión de vegetación, ofrece una excelente vista panorámica de la ciudad, al igual que otras dos iglesias cercanas: el Santuario Nossa Senhora do Sameiro, un importante lugar de culto mariano, y la Iglesia de Santa Maria da Falperra. Bom Jesus es considerado uno de los santuarios más bellos de Portugal y es una referencia del arte barroco en el Pais, con una historia que se remonta al siglo XIV.
Para llegar allí, se puede subir la famosa escalera a la iglesia neoclásica, con 581 escalones, rodeada de magníficos jardines y hoteles. Alternativamente, se puede usar el ascensor que lleva a la parte superior de la escalera. Este ascensor, que funciona desde 1882, es único en la Península Ibérica y el más antiguo del mundo que sigue activo. El elevador se mueve por contrapeso de agua, con dos cabinas, que están conectadas por un cable. La forma original en que funciona este elevador lo convierte en una de las piezas de ingeniería más extraordinarias de Portugal.
Además, también es posible llevar el automóvil arriba y hacer un picnic en los magníficos jardines de Bom Jesus y así disfrutar del aire fresco de la naturaleza y de los impresionantes paisajes. La puesta de sol vista desde aquí le da un sentido completamente nuevo al concepto de "hora dorada".
En los últimos años, la Universidad de Minho y la calidad de la arquitectura contemporánea han inculcado una atmósfera de vitalidad juvenil que ha llevado a esta antigua ciudad a un nivel inesperado de modernidad.
Todos estos atributos fueron primordiales para que Braga fuera considerado el **Segundo Mejor Destino de Europa en 2019** en el concurso promovido por "**European Best Destinations**".

Jardim de Santa Bárbara

Más info: braga.360portugal.com

Mission 10.000: BATERÍAS

Octubre, 10 y 11, 2019 | **INL**, Braga (Portugal)

Nanogateway Conferencia Internacional

Partner principal:

TÉCNICO LISBOA

Organizador:

INL
INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY

Partners regionales Interreg-POCTEP:

CCDR Algarve

JUNTA DE ANDALUCIA
Agencia de Innovación y Desarrollo de Andalucía IDEA
CONSEJERÍA DE ECONOMÍA, INNOVACIÓN, CIENCIA Y EMPLEO

CCDR ALENTEJO

FUNDECYTPCTEX
un espacio para innovar

ccdrc
comissão de coordenação e desenvolvimento regional do centro

competitividad empresarial ice

Junta de Castilla y León

CCDRn
Comissão de Coordenação e Desenvolvimento Regional do Norte

gain
AXENCIA DE INNOVACIÓN

USC
UNIVERSIDADE DE SANTIAGO DE COMPOSTELA

Interreg
España - Portugal
Fondo Europeo de Desarrollo Regional
Fundo Europeu de Desenvolvimento Regional

nano GATEWAY

mission 10.000 conference

Mission 10.000: BATTERIES

October 10th - 11th, 2019 | **INL**, Braga (Portugal)

nanoGateway International Conference

Contributed Talks
Apresentações Orais
Presentaciones Orales
- ABSTRACTS -

Mission 10.000: BATTERIES

October 10th - 11th, 2019 | **INL**, Braga (Portugal)

nanoGateway International Conference

Contributed Talks List
Lista de Apresentações Orais
Lista de Presentaciones Orales

:: Compositional mapping of LiNixCoyMnzO2 cathode materials
Cristiana Alves, INL

:: High Power Blue Lasers, a disruptive technology for battery welding
Victor Blanco, Laser 2000 SAS / NUBURU

:: Ionic Liquids: next generation electrolytes
Oscar Cabeza, University of Coruña

:: Nanoconfined ionic Liquids and hybrid ionogels: Tuning the Electrolyte-Electrode Interface
Luis Miguel Varela, University of Santiago de Compostela

:: How relevant is for asset operators to access cell data in large scale stationary Li-ion battery projects: the case of 2nd life batteries
Mario Simões, EDP Inovação

:: Free-Standing N-Graphene as Conductive Matrix For Ni(OH)2 based Supercapacitive Electrodes
Kush Upadhyay, IST

:: High-Capacitance Negative Electrode based on Cobalt Phosphide Nanocrystals
Nan Zhang, INL

Compositional mapping of $LiNi_xCo_yMn_zO_2$ cathode materials

C. F. Almeida Alves[1], Qiang Xie[2], Arumugam Manthiram[2], P. J. Ferreira[1, 2, 3]

(1) INL - International Iberian Nanotechnology Laboratory, Av. Mestre José Veiga s/n, 4715-330 Braga, Portugal

(2) Materials Science and Engineering Program, University of Texas at Austin, Austin, Texas 78712, USA

(3) Mechanical Engineering Department and IDMEC, Instituto Superior Técnico, University of Lisbon, Av. Rovisco Pais, 1049-001 Lisboa, Portugal

$LiNi_xCo_yMn_zO_2$ (NMC) cathode material comprises the new generation of Li-ion batteries (LIB). It is reported that NCM materials are composed by $LiMO_2/Li_2MO_3$ layers. $LiMO_2$ is associated with a trigonal ($R\bar{3}m$) phase whereas Li_2MO_3 is associated with a monoclinic (C2/m) phase. In effect, literature reports that $LiMO_2$ (where *M* represents Ni, Co or Mn) is stabilized by the presence of Li_2MO_3 layer, improving capacity and voltage operation. The Li_2MO_3, besides storing Li^+ also facilitates the Li diffusion pathways. [1] Yet, these layered materials are susceptible to phase transformations during charge/discharge due to the Li mobility, which deteriorates the cycling performance of Li-ion cathodes. So far, all studies have been focused on single-phase NMC cathodes. However, due to the complexity of the industrial process NMC batteries do not exhibit this configuration. Instead, they are composed by micrometer polycrystalline particles with a mixture of Li-rich and Ni-rich phases.

The aim of this work is to understand the changes in phase and chemical distribution as a function of Ni content in polycrystalline NCM cathode materials. In particular, the chemical composition and structure were investigated by FIB-SEM, double-corrected TEM-STEM, and EDS/EELS mapping. STEM-EDS results revealed differences in structure, which are concomitant with variations in chemical composition across the particle, in particular segregation of Mn, which is dependent on the Ni content.

The authors would like to acknowledge that this project has received funding from the EU Framework Programme for Research and Innovation H2020, scheme COFUND – Co-funding of Regional, National and International Programmes, under Grant Agreement 713640.

References:

[1] K. A. Jarvis, Z. Deng, L. F. Allard, A. Manthiram, and P. J. Ferreira, *Chem. Mater.*, vol. 23, pp. 3614–3621 (2011).

High Power Blue Lasers, a disruptive technology for battery welding

Jean Michel Pelaprat (1), Victor Blanco (2)

(1) NUBURU Inc.

(2) LASER 2000 SAS

Laser applications have been playing a key role in the Automotive Industry since they were first adopted in an assembly line in 1973. Lasers have become an indispensable tool in manufacturing and are being used in a broad range of applications, maximizing productivity and reducing manufacturing costs thanks to their flexible energy delivery, stability, robustness, restricted heat input, minimal distortion, high processing speed and ease of integration.

Automotive laser welding has replaced traditional joining methods, including arc, resistance and ultrasonic welding and other conventional processes. There are, however, some materials which could not be so successfully welded with traditional lasers, as these operate at infrared wavelengths which are poorly absorbed by “yellow metals”, of which copper is a prime example.

Copper is widely used in electric and electronic automotive components, and the welding of such components presents a new array of challenges: to maximize performance, each component, and each element within these components, must be joined with the highest mechanical and electrical fidelity, a task that was hard to accomplish with existing laser technologies, resulting in poor quality and slow processing speeds.

Blue wavelengths are absorbed more than ten times more efficiently than infrared, welding copper joints with unmatched quality (no voids or spattering) and speed, making them an attractive option for boosting productivity where copper welding is required. Copper absorbs “blue” much better, leading to direct advantages in welding performance and making blue lasers the optimum choice to enhance the fabrication of essential components such as batteries and motors.

Ionic Liquids: next generation electrolytes

Oscar Cabeza (1), Luis Miguel Varela (2)

(1) Grupo Mesturas. Dpto. de Física e Ciencias da Terra. Univ. da Coruña (Spain).

(2) Grupo de Nanomateriais, Fotónica e Materia Blanda (NAFOMAT). Dpto. de Física de Partículas. Univ. de Santiago de Compostela (Spain).

As it is well known, ionic liquids (ILs) are a very promising group of molten salts at room temperature [1]. They have been postulated as firm candidates to create a new generation of electrolytes to improve batteries performance. This is due to IL characteristics, as very low vapour pressure, wide chemical window, thermal and chemical stability and average ionic conductivity [2]. In addition, some properties of the ILs can be tuned, choosing the adequate pair of cation and anion, many of their physico-chemical characteristics changes completely [3]. And there exist more than a million different compounds in the IL family… If we add a cosolvent (water, ethanol, carbonates, dMSO…) to the IL, even in a tiny quantity, their physical properties change again, some of them, as viscosity or ionic conductivity, dramatically [4]. In any case, to use the ILs as electrolytes for any electrochemical process, we must add another salt with active metal cations suitable for redox reaction. In this communication we will review the state of the art of electrolytes based in ILs, focusing in the most promising mixtures used up to date, both with Li^+ as cation, but seeking for other univalent or multivalent cations. These latter electrolytes, based in Mg^{+2} or Al^{+3}, would be very interesting due to the abundance of those metals in nature respecting lithium.

The financial support of the Spanish Ministry of Economy and Competitiveness (Grants MAT 2014-57943-C3-1-P, MAT 2014-57943-C3-3-P, MAT 2017-89239-C2-1-P, MAT 2017-89239-C2-2-P) is gratefully acknowledged. Moreover, this work was funded by the Xunta de Galicia (ED431D 2017/06, ED431E 2018/08 and GRCED431C 2016/001). All these research projects were partially supported by FEDER.

References:

[1] D.R. MacFarlane, N. Tachikawa, M. Forsyth, J.M. Pringle, P.C. Howlett, G.D. Elliott, J.H. Davis, M. Watanabe, P. Simon, C.A. Angell, Energy Environ. Sci. 7, 232–250 (2014).

[2] N. V Plechkova, K.R. Seddon, Chem. Soc. Rev. 37, 123–150 (2008).

[3] L. M. Varela, J. Carrete, M. García, L. J. Gallego, M. Turmine, E. Rilo, O. Cabeza, Fluid Phase Equilibr. 298, 280-286 (2010).

[4] E. Rilo, J. Vila, S. Garcia-Garabal, L.M. Varela, O. Cabeza, J. Phys. Chem. B 117, 1411-1418 (2013).

Nanoconfined ionic Liquids and hybrid ionogels: Tuning the Electrolyte-Electrode Interface

Luis Miguel Varela,[(1)] Hadrián Montes-Campos, [(1)] José M. Otero-Mato, [(1)] Oscar Cabeza[(2)]

(1) Grupo de Nanomateriais, Fotónica e Materia Blanda (NAFOMAT). Dpto. de Física de Partículas. Univ. de Santiago de Compostela (Spain).

(2) Grupo Mesturas. Dpto. de Física e Ciencias da Terra. Univ. da Coruña (Spain).

Ionogels, ionic-liquid (IL)-based hybrid materials, are currently under intense scrutiny since they combine the advantages of liquid electrolytes (high conductivity) with the mechanical rigidity demanded by applications in actual batteries. In this communication we report a review of computational studies of the structure of the electric double layer (EDL) in ionic liquids (ILs) and ionogels and their mixtures with cosolvents and inorganic salts close to the electrochemical interface [1-3]. Specifically, we analyze in detail the lateral structure of the layers closest to electrochemical interfaces at different concentrations of mixtures of these densely ionic solvents with molecular cosolvents and inorganic salts, as well as different percentages of vacancy defects on the electrodes. Structural transitions between different mesophases (stripes, hexagons) at the interfacial layer are seen to be induced by perturbation that couple to the charge density at the innermost layer of the EDL and they are systematically analyzed, as well as the occurrence of preferential adsorption and desorption of the different species at the electrochemical interface and the 3D study of the EDL. Our results open the door to tuning the electrochemical interface of these advanced electrolytes.

The financial support of the Spanish Ministry of Economy and Competitiveness (Grants MAT 2014-57943-C3-1-P, MAT 2014-57943-C3-3-P, MAT 2017-89239-C2-1-P, MAT 2017-89239-C2-2-P) is gratefully acknowledged. Moreover, this work was funded by the Xunta de Galicia (ED431D 2017/06, ED431E 2018/08 and GRCED431C 2016/001). All these research projects were partially supported by FEDER.

References:

1. V. Gómez-González, B. Docampo-Álvarez, T. Méndez-Morales, O. Cabeza, V. B. Ivaništšev, M. V. Fedorov, L. J. Gallego and L. M. Varela, *Phys. Chem. Chem. Phys.,* 19, 846-853 (2017).

2. H. Montes-Campos, J. M. Otero-Mato, T. Méndez-Morales, O. Cabeza, L. J. Gallego, A. Ciach, and L. M. Varela, *Phys. Chem. Chem. Phys.,* 19, 24505-24512 (2017).

3. J. M. Otero-Mato, H. Montes-Campos, O. Cabeza, D. Diddens, A. Ciach, L. J. Gallego and L. M. Varela, *Phys. Chem. Chem. Phys.,* 20, 30412-30427 (2018).

4. H. Montes-Campos, J. M. Otero-Mato, R. Carlos Longo, O. Cabeza, L. J. Gallego, L. M. Varela, J. Mol. Liq. 289, 111083-1-8 (2019).

Nanoconfined ionic Liquids and hybrid ionogels: Tuning the Electrolyte-Electrode Interface

Luis Miguel Varela,(1) Hadrián Montes-Campos, (1) José M. Otero-Mato, (1) Oscar Cabeza(2)

(1) Grupo de Nanomateriais, Fotónica e Materia Blanda (NAFOMAT). Dpto. de Física de Partículas. Univ. de Santiago de Compostela (Spain).

(2) Grupo Mesturas. Dpto. de Física e Ciencias da Terra. Univ. da Coruña (Spain).

Ionogels, ionic-liquid (IL)-based hybrid materials, are currently under intense scrutiny since they combine the advantages of liquid electrolytes (high conductivity) with the mechanical rigidity demanded by applications in actual batteries. In this communication we report a review of computational studies of the structure of the electric double layer (EDL) in ionic liquids (ILs) and ionogels and their mixtures with cosolvents and inorganic salts close to the electrochemical interface [1-3]. Specifically, we analyze in detail the lateral structure of the layers closest to electrochemical interfaces at different concentrations of mixtures of these densely ionic solvents with molecular cosolvents and inorganic salts, as well as different percentages of vacancy defects on the electrodes. Structural transitions between different mesophases (stripes, hexagons) at the interfacial layer are seen to be induced by perturbation that couple to the charge density at the innermost layer of the EDL and they are systematically analyzed, as well as the occurrence of preferential adsorption and desorption of the different species at the electrochemical interface and the 3D study of the EDL. Our results open the door to tuning the electrochemical interface of these advanced electrolytes.

The financial support of the Spanish Ministry of Economy and Competitiveness (Grants MAT 2014-57943-C3-1-P, MAT 2014-57943-C3-3-P, MAT 2017-89239-C2-1-P, MAT 2017-89239-C2-2-P) is gratefully acknowledged. Moreover, this work was funded by the Xunta de Galicia (ED431D 2017/06, ED431E 2018/08 and GRCED431C 2016/001). All these research projects were partially supported by FEDER.

References:

1. V. Gómez-González, B. Docampo-Álvarez, T. Méndez-Morales, O. Cabeza, V. B. Ivaništšev, M. V. Fedorov, L. J. Gallego and L. M. Varela, *Phys. Chem. Chem. Phys.,* 19, 846-853 (2017).

2. H. Montes-Campos, J. M. Otero-Mato, T. Méndez-Morales, O. Cabeza, L. J. Gallego, A. Ciach, and L. M. Varela, *Phys. Chem. Chem. Phys.,* 19, 24505-24512 (2017).

3. J. M. Otero-Mato, H. Montes-Campos, O. Cabeza, D. Diddens, A. Ciach, L. J. Gallego and L. M. Varela, *Phys. Chem. Chem. Phys.,* 20, 30412-30427 (2018).

4. H. Montes-Campos, J. M. Otero-Mato, R. Carlos Longo, O. Cabeza, L. J. Gallego, L. M. Varela, J. Mol. Liq. 289, 111083-1-8 (2019).

Mission 10.000: BATTERIES
October 10th - 11th, 2019 | INL, Braga (Portugal)
nanoGateway International Conference

Free-Standing N-Graphene as Conductive Matrix For $Ni(OH)_2$ based Supercapacitive Electrodes

Kush K. Upadhyay[1,6], N. Bundaleska[2], M. Abrashev[3], N. Bundaleski[4], O. M. N. D. Teodoro[4], I. Fonseca[5], André Mão de Ferro[6], Rui Pedro Silva[6], E. Tatarova[2], M.F. Montemor[1]

(1) Centro de Química Estrutural-CQE, Departamento de Engenharia Química, Instituto Superior Técnico, Universidade de Lisboa,1049-001 Lisboa, Portugal.

(2) Instituto de Plasmas e Fusão Nuclear, Instituto Superior Técnico, Universidade de Lisboa, Lisboa-1049, Portugal.

(3) Faculty of Physics, Sofia University, 1164 Sofia, Bulgaria

(4) Departamento de Física, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, 2829 - 516, Portugal

(5) Universidade Nova de Lisboa, 2829 - 516, Portugal

(6) Charge2C-NewCap, Taguspark, Edificio Inovação II, Caixa Correio 411, 2740-122 Porto Salvo, Oeiras, Portugal

Free-standing N-doped graphene (NG2N1O) sheets with 2.3 at. % of nitrogen and residual oxygen content were synthesized using low-pressure microwave plasma.

A composite made with $Ni(OH)_2$ and NG2N1O was prepared by the hydrothermal route. Physico-chemical characterizations evidenced the formation of crystalline β-phase of $Ni(OH)_2$ nanoplates interconnected with graphene nanosheets.

The electrochemical results of N-graphene electrodes evidenced very good supercapacitive response with high rate capability of 97%, negligible charge transfer resistance of 0.05 Ω. cm^2 and very low time constant of 50 ms. The specific capacity of the $Ni(OH)_2$ + NG2N1O composite increased 20% compared to $Ni(OH)_2$ (107 mAh g^{-1} *vs.* 86 mAh g^{-1}, respectively) and the rate capability was 75 % at current density of 10 A g^{-1}, higher than $Ni(OH)_2$ which retained only 34.4 %. The composite showed excellent stability, by retaining 92% of its initial specific capacity after 4000 charge-discharge cycles. Furthermore, electrochemical impedance spectroscopy evidenced that graphene decreased the charge transfer resistance and diffusional contributions, while enhancing the capacitive behaviour and the high frequency response of the electrodes.

An asymmetric cell was assembled using activated carbon as negative electrode and $Ni(OH)_2$ + NG2N1O as positive electrode. The cell displayed good capacitive response in a potential window of 1.8 V, in aqueous electrolyte, stored a maximum energy density of 38.64 Wh kg^{-1} at power density of 450 W kg^{-1} and retained 16 Wh kg^{-1} at power density of 4.7 kW kg^{-1}.

This work was performed under the framework of PEGASUS (Plasma Enabled and Graphene Allowed Synthesis of Unique nano-Structures) project, funded by the European Union's Horizon research and innovation programme under grant agreement No 766894) and project UID/QUI/00100/2019 Fundação para a Ciência e a Tecnologia (FCT).

High-Capacitance Negative Electrode based on Cobalt Phosphide Nanocrystals

Nan Zhang(1), Junyuan Xu(1), Bin Wei(1), Junjie Li(1), Isilda Amorim(1), Rajesh Thomas(1), S. Mouli Thalluri(1) and Weiya Zhou(2), Sishen Xie(2), Lifeng Liu(1),*

(1) International Iberian Nanotechnology Laboratory (INL), Av. Mestre Jose Veiga, 4715-330 Braga, Portugal

(2) Institute of Physics, Chinese Academy of Sciences P.O.Box 603,Beijing 100190,China

Transition metal phosphides (TMPs), because of their metalloid characteristics and high conductivity, are emerging as high-performance and promising electrode materials in asymmetric supercapacitors.[1,2] However, the TMP-based asymmetric supercapacitors by far suffer from unsatisfactory specific capacitance for use in the negative electrodes and result in high weight of the complete devices, impeding their practical application. In this work, we synthesized cobalt phosphide (CoP) nanocrystals on carbon nanofiber (CNF), and fabricated a binder-free hierarchical CoP/CNF/carbon nanotube (CoP/CNF/CNT) negative electrode by using free-standing reticulate CNT film as collector. The CoP/CNF/CNT electrode shows a remarkably high specific capacitance of 744.1 F g^{-1} at a scan rate of 10 mV s^{-1}, which is significantly higher than that of other CoP-based electrodes reported previously.[3] Furthermore, owing to the light-weight and ultra-thin nature of CNT films, the specific capacitance of the overall electrode is still high, amounting to 211.0 F g^{-1} at current density of 0.5 A g^{-1}. Additionally, we also fabricated an asymmetric supercapacitor using NiP as positive electrode. The as-prepared asymmetric supercapacitor achieved both excellent specific capacitance of 169 F g^{-1} and good stability, which may expand the application range of supercapaictors.

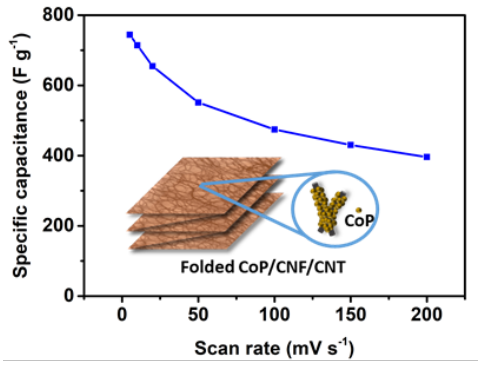


Figure 1. *Specific capacitances of CoP/CNF/CNT negative electrode at different scan rates. Inset: schematic of CoP/CNF/CNT negative electrode*

Financial support from FCT-UT Austin project (UTAP-EXPL/CTE/0008/2017) is acknowledged.

References:

[1] S. Carenco, D. Portehault, C. Boissière, N. Mézailles and C. Sanchez, Chem. Rev., 113, 7981 (2013).
[2] K. Zhou, W. Zhou, L. Yang, J. Lu, S. Cheng, W. Mai, Z. Tang, L. Li and S. Chen, Adv. Funct. Mater., 25, 7530 (2015).
[3] Zheng, Z.; Retana, M.; Hu, X.; Luna, R.; Ikuhara, Y. H.; Zhou, W., ACS Appl. Mater. Inter., 9, 16986 (2017).

Scientific Posters
Posters científicos
- ABSTRACTS -

Mission 10.000: BATTERIES

October 10th - 11th, 2019 | **INL**, Braga (Portugal)

nanoGateway International Conference

Poster List
Lista de Posters Científicos

	AUTHOR	POSTER TITLE
01	Alberto Adan Mas	From bench-scale to prototype: case study on a hybrid energy storage device
02	Alvaro Caballero	Advances in sustainability for Lithium-Sulfur battery technology: Biomass-derived carbon electrodes
03	Alvaro Caballero	Advances in safety for Lithium-Sulfur battery technology: alternative anodes and electrolytes
04	Alvaro Caballero	Advances in performance for Lithium-Sulfur battery technology: Graphene-based electrodes
05	Ana Mafalda Macatrao	Effect of Magnetic Field on the Electrodeposition of Copper-Iron Nanofoams
06	Bruno Xavier	Synthesis of nanostructured transition metal phosphides via a one-step vapor-solid reaction method for electrochemical energy storage
07	Carlos Miguel Costa	Metal–organic framework reinforced poly(vinylidene fluoride) membranes for lithium-ion battery separators
08	Eduardo Lopez	Testing and evaluation of battery technologies for commercial and residential applications in AGERAR project
09	Kamil Jasso	Application of carrageenans in lithium-sulfur batteries
10	Mario Andre Madeira de Almeida	Manganese Sulfide Crystallites - Development and Supercapacitor application
11	Rajesh Thomas	Improved lithium storage performance of Bi2Se3 electrode with effective surface modification via conductive coating
12	Zhixin Tai	High-shear exfoliation technology to produce ultrathin 2D nanosheets for high capacity and long-life alkali-ion batteries
13	Ziyu Lu	Tips-covered anode achieving uniform lithium deposition for stable lithium metal batteries
14	Ziyu Lu	Plasma assisted sponge-like carbon coating towards stable lithium anodez

From bench-scale to prototype: case study on a hybrid energy storage device

A. Adan-Mas[1], P. Arévalo-Cid[1],T. M. Silva[2], J. Crespo[3], M. F. Montemor[1]

(1) Centro de Química Estrutural-CQE, DEQ, Instituto Superior Tecnico, Universidade de Lisboa, 1049-001, Lisboa, Portugal

(2) ADEM, GI-MOSM, ISEL-Instituto Superior de Engenharia de Lisboa, Instituto Politécnico de Lisboa, Lisboa, Portugal

(3) Arquiled Projectos de Iluminação S.A., Edifício Arcis, R. Ivone Silva 6, 17Esq, 1050-124, Lisboa, Portugal

During the last decade, research has focused intensively in producing novel materials, specifically tailored for enhanced electrochemical response and stable properties to move further the current state-of-the art. Lithium-ion batteries are, to the date, the most efficient energy storage devices, coping with a great percentage of the market. Nonetheless, technological developments impose energy storage requirements that Li-ion batteries cannot meet. Alternative technologies are, therefore, under investigation; from lithium-air batteries to supercapacitors. The present work reports the challenges faced, at an experimental level, during the development of a hybrid supercapacitor prototype. Scalable processes were exclusively used so the prototype can serve as basis to design a pre-commercial device. Consequently, an aqueous-based hybrid device, consisting of a supercapacitive carbon-based negative electrode and a battery-like nickel-cobalt hydroxide positive electrode has been built to meet the energetic demands of a 12W solar-powered LED lamp that must be functional during a period of 12h.

Acknowledgements: Project LLESA, supported by Competitivity and Internationalization Operational Programme (COMPETE 2020), under the PORTUGAL 2020 Partnership Agreement, through the European Regional Development Fund (ERDF); Fundação para a Ciência e a Tecnologia (FCT) under the funding UID/QUI/00100/2019 and C2C-NewCap.

Mission 10.000: BATTERIES
October 10th - 11th, 2019 | INL, Braga (Portugal)
nanoGateway International Conference

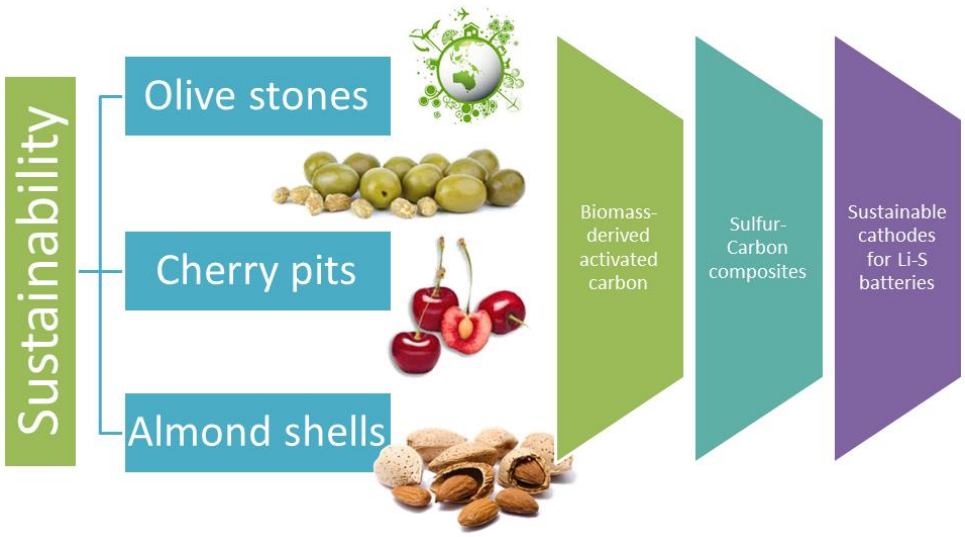
Advances in sustainability for Lithium-Sulfur battery technology: Biomass-derived carbon electrodes

Celia Hernández, Fernando Luna, Almudena Benítez, Alvaro Caballero, Julián Morales

Dpto. Química Inorgánica, IUNAN, Campus de Rabanales, Universidad de Córdoba, Spain

Lithium–sulfur (Li–S) batteries have been considered one of the most promising energy storage systems for several years due to their numerous advantages, such as their high specific energy (2600 Wh kg^{-1}) and specific capacity (1675 mAh g^{-1}) [1]. The use of activated carbon seems to be a suitable solution to known problems by virtue of its properties, namely, its high conductivity and highly developed porous structure which is a fundamental property to be able to accommodate sulfur and improve conductivity. However, to obtain these carbonaceous materials, expensive preparation processes or non-sustainable carbon sources are usually necessary. The project "*Advances in Lithium-Sulfur battery technology: performance, safety and sustainability* (MAT2017-87541-R)" addresses this challenge by implementing the use of biomass-derived carbon as matrix for sustainable electrodes.

Olive stone, cherry pits and almond shells have been proposed as sources of activated carbon with the properties required to confine sulfur in its structure. Different methods of activation and preparation of composites with sulfur have been developed, obtaining electrodes with excellent electrochemical performance in Li-S cells. The electrodes based on this activated carbon require less complex processing methods than those reported for other high-performance cathodes in Li–S batteries, demonstrating a clear advantage in terms of sustainability, cost and scalability.



Acknowledgement: This work was performed with the financial support of the Ministerio de Economía y Competitividad (No. MAT2017-87541-R) and Junta de Andalucía (Group FQM-175).

References:

[1] D. Bresser, S. Passerini, B. Scrosati, Chem. Commun. 49, 10545–10562 (2013).

Mission 10.000: BATTERIES
October 10th - 11th, 2019 | INL, Braga (Portugal)
nanoGateway International Conference

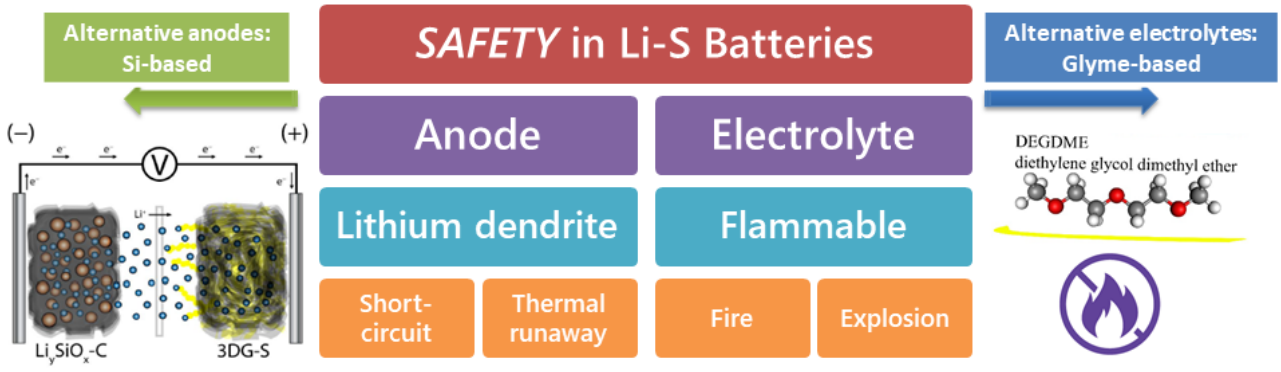
Advances in safety for Lithium-Sulfur battery technology: alternative anodes and electrolytes

Almudena Benítez[1], Alvaro Caballero[1], Julián Morales[1], Jusef Hassoun[2]

[1] Dpto. Química Inorgánica, IUNAN, Campus de Rabanales, Universidad de Córdoba, Spain
[2] Department of Chemical and Pharmaceutical Sciences, University of Ferrara, Ferrara, Italy

Despite the appealing features of Lithium-Sulfur batteries in terms of cost, environmental impact, and performance, their commercialization has been limited so far owing to issues related to the safety, especially for two basic components: lithium anode and electrolyte. Indeed, the use of lithium metal at the negative side may lead to safety issues associated with possible lithium dendrite growth, short circuit, and thermal runaway [1]. The electrolyte suffers from a safety issue ascribed to the use of highly-flammable solvents [2]. The project "*Advances in Lithium-Sulfur battery technology: performance, safety and sustainability* (MAT2017-87541-R)" addresses this challenge by analysing the use of alternative anodes and electrolytes.

The safety and stability of the sulfur cell may be increased by replacing the lithium-metal anode by lithium-alloying materials. In the project, a new promising battery formed by combining a sulfur–3D graphene composite cathode and a nanostructured silicon–carbon anode has been designed. The battery reported belongs to a class of full lithium-ion sulfur cells studied in the laboratory by systematically varying the features of the electrode and electrolyte components to explore a promising high-energy, Li-metal-free, and low-costing battery. In addition, glyme-based electrolytes have been studied as non-flammable alternatives for Li-S batteries. The electrolyte composition ensures both very low flammability and good performance as demonstrated by thermal analysis and electrochemical tests.



Acknowledgement: This work was performed with the financial support of the Ministerio de Economía y Competitividad (No. MAT2017-87541-R) and Junta de Andalucía (Group FQM-175).

References:

[1] A. Manthiram, Y.Z. Fu, S.H. Chung, C.X. Zu, Y.S. Su, Chem. Rev., 114, 11751–11787 (2014).

[2] L. Carbone, M. Gobet, J. Peng, M. Devany, B. Scrosati, S. Greenbaum, J. Hassoun, ACS Appl. Mater. Interfaces 7, 13859–13865 (2015).

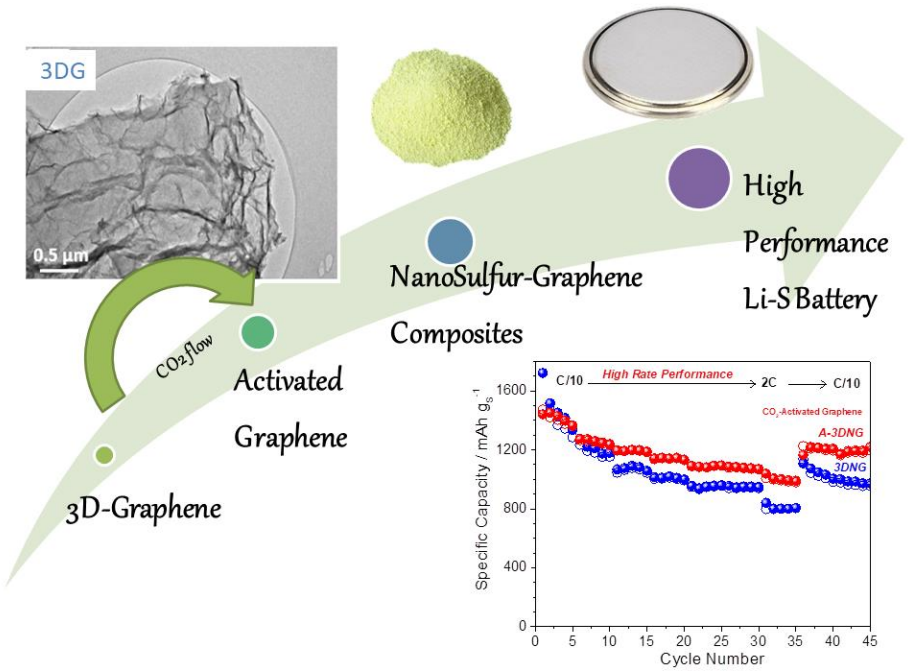
Advances in performance for Lithium-Sulfur battery technology: Graphene-based electrodes

Almudena Benítez, Alvaro Caballero, Julián Morales

Dpto. Química Inorgánica, IUNAN, Campus de Rabanales, Universidad de Córdoba, Spain

There is a great interest in the development of high energy and power density systems to achieve progress in hybrid or fully electric vehicles as well as in renewable energies. Li-S battery technology is a strong candidate to achieve this goal. Nevertheless, Li-S batteries present drawbacks that may lead to active material loss at the cathode, and decrease of the cell performance in terms of efficiency and reversible capacity values [1]. The project "*Advances in Lithium-Sulfur battery technology: performance, safety and sustainability* (MAT2017-87541-R)" addresses this challenge by implementing the use of graphene-based cathodes.

Graphene activation is used as a viable strategy to induce a micropore system and further improve the battery performance. In this project, a three-dimensional (3D) N-doped graphene was physically activated with CO_2, a clean and single step process, and used for the preparation of a nano-sulfur composite. The outstanding electrochemical results support the use of physical activation as a simple and efficient alternative to improve the performance of carbons as an S host for high-performance Li-S batteries.



Acknowledgement: This work was performed with the financial support of the Ministerio de Economía y Competitividad (No. MAT2017-87541-R) and Junta de Andalucía (Group FQM-175).

References:

[1] A. Manthiram, Y.Z. Fu, S.H. Chung, C.X. Zu, Y.S. Su, Chem. Rev., 114, 11751–11787 (2014).

Effect of Magnetic Field on the Electrodeposition of Copper-Iron Nanofoams

M. Macatrão (1), M.F. Montemor (1), M.J. Carmezim (2)

(1) CQE-Centro de Química Estrutural, Instituto Superior Técnico, Universidade de Lisboa, 1049-001 Lisboa, Portugal

(2) ESTSetúbal, Instituto Politécnico de Setúbal, 1959-007 Setúbal, Portugal

The development of innovative, efficient and inexpensive electrochemical energy storage devices has become one of the most challenging research areas. In this context, supercapacitors are attracting attention as a result of several advantages compared to other storage devices. Supercapacitors are increasingly recognized as the most promising solution for high power energy storage. The present work concerns the electrochemical preparation of copper-iron metallic nanofoams for supercapacitors and their respective characterization. The influence of an imposed external magnetic field during the electrodeposition on the structure and electrochemical behaviour of the materials was studied. Magnetic electroplating is an attractive and interesting interdisciplinary area that enables a single step and low-cost route for mass production of electrodes, binder free, fast and easy to tailor. Under certain current density, time and bath conditions metallic nanofoams were deposited on stainless steel by electrodeposition in a dynamic hydrogen bubble template (DHBT). The influence of external magnetic field on the electrodeposition process, deposited mass, crystallographic structure, chemical composition, morphology and electrochemical performance of the electrodeposited samples were studied by X-ray diffraction (XRD), scanning electron microscopy (SEM), energy dispersive spectroscopy (EDS) and cyclic voltammetry (CV). The results show that the external magnetic field during electrodeposition has a significant effect on Cu-Fe nanofoams. It was observed that the magnetic field can introduce a modification on the surface morphology and influence the preferential growth direction of the Cu-Fe structure.

Mission 10.000: BATTERIES
October 10th - 11th, 2019 | INL, Braga (Portugal)
nanoGateway International Conference

Synthesis of nanostructured transition metal phosphides via a one-step vapor-solid reaction method for electrochemical energy storage

Bruno Xavier [(1)], Rajesh Thomas [(1)], Nan Zhang [(1)], Ziyu Lu [(1,2)], Zhixin Tai [(1)], Lifeng Liu [(1),*]

(1) INL - International Iberian Nanotechnology Laboratory, Avenida Mestre José Veiga s/n, 4715-330Braga, Portugal

(2) School of Engineering and Technology, China University of Geosciences at Beijing, Beijing 100083, PR China.

The recent advances in the synthesis of transition metal phosphides (TMPs) are mostly based on laborious multistep procedures to engineer an intended structure. Here we report a one-step vapor solid reaction method for the synthesis of morphology-controllable TMPs, which takes advantage of the direct reaction of metallic powders and red phosphorus (RP) vapor at elevated temperatures and under inert atmosphere (N_2). This synthesis strategy allows to obtain nanostructured Ni-P and Fe-P electrode materials, whose electrochemical performances were then studied as anodes for lithium ion batteries by galvanostatic charge/discharge tests and cyclic voltammetry. One of the obtained structures, using Ni fine particles, consists of Ni_5P_4 nanosheet flowers with a specific reverse capacity of 744 mAh/g and an initial coulombic efficiency (CE) of 82,22 %. In addition to being a facile and straightforward method capable of obtaining functional electrode materials, this strategy holds substantial promise for the mass production of nanostructured TMPs with energy storage applications, since both metal powders and red phosphorus are commercially available and are inexpensive.

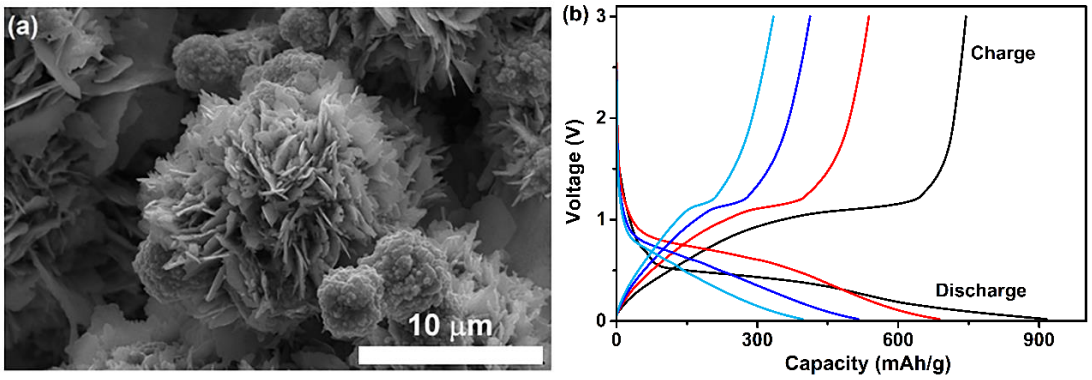


Fig. 1 – (a) SEM image of Ni_5P_4 nanosheet flowers. (b) Galvanostatic charge-discharge voltage profiles of the nanosheet flowers at 0.1 Ag^{-1}.

Acknowledgement: The authors acknowledge the project "Nanotechnology Based Functional Solutions" (NORTE-01-0145-FEDER-000019), supported by Norte Portugal Regional Operational Programme (NORTE2020), under the Portugal 2020 Partnership Agreement through the European Regional Development Fund (ERDF), as well as the financial support from Fundação para a Ciência e a Tecnologia through FCT-UT Austin project (MePhEES, UTAP-EXPL/CTE/0008/2017).

References:

[1] Khang Ngoc Dinh; Liang, Qinghua; Du, Cheng-Feng; et al., Nano Today, 25, 99-121 (2019)
[2] Ma, Chunrong; Deng, Changjian; Liao, XiaoZhen; et al., ACS Applied Energy Materials, 1, 7140-7145 (2018)
[3] Lin, Cheng; Hu, Renzong; Liu, Jun; et al., Journal of Alloys and Compounds, 763, 296-304 (2018)
[4] Bai, Jing; Xi, Baojuan; Mao, Hongzhi; et al., Advanced Materials, 30, 1802310 (2018)
[5] Sun, Meng; Liu, Huijuan; Qu, Jiuhui; et al., Advanced Energy Materials, 6, 34 (2016).

Metal–organic framework reinforced poly(vinylidene fluoride) membranes for lithium-ion battery separators

A. Valverde [(1)], Roberto Fernández de Luis [(1)], R. Gonçalves [(2)] M. M. Silva [(2)], A. Fidalgo [(1)], C. M. Costa [(2,3)], S. Lanceros-Méndez [(1,4)]

(1) BCMaterials (Basque Centre for Materials, Applications & Nanostructures), Bld. Martina Casiano, 3rd. Floor UPV/EHU Science Park Barrio Sarriena s/n 48940 Leioa, Spain

(2) Centro de Química, Universidade do Minho, 4710-057 Braga, Portugal

(3) Centro de Física, Universidade do Minho, 4710-057 Braga, Portugal

(4) IKERBASQUE, Basque Foundation for Science, 48013 Bilbao, Spain

The constant technological development and the increasing mobility lead to the necessity of new ways of energy generation and storage [1].
Lithium ion batteries are increasingly being used in portable devices and show some advantages when compared to other systems such as nickel-cadmium and nickel-metal, due to higher energy storage, high capacity and higher number of charge-discharge cycles. Membrane separators are one of the key issues in battery systems in order to control the number and mobility of lithium ions between the cathode and anode. The most important characteristics of these membranes are porosity, ionic conductivity mechanical, thermal and chemical stability [2].
Poly(vinylidene fluoride) (PVDF) are known for its excellent chemical resistance, mechanical properties and outstanding electroactive properties [3]. Also, metal-organic framework (MOF) materials can be used in lithium-ion batteries for both electrodes and separator membranes, the later in the form of composite porous membranes taking, mainly based on their tunable electrical properties, large surface area and highly ordered pores with tailored porosity.
In the present work, MOF/PVDF membranes were prepared by non-solvent induced phase separation with different MOFs content between 5 wt% to 15 wt%. MOF808 was synthesized and polycrystalline samples with diameter around 50 nm obtained. Microstructural, mechanical, thermal, and electrical properties of the MOF/PVDF membranes were characterized showing an improvement of battery cycling performance as a function of MOF content, showing the suitability of the developed membrane for battery applications.

The authors thank the FCT (Fundação para a Ciência e Tecnologia) for financial support under the framework of Strategic Funding grants UID/FIS/04650/2019, UID/EEA/04436/2013 and UID/QUI/0686/ 2016; and project PTDC/FIS-MAC/28157/2017. The authors also thank the FCT for financial support under grant SFRH/BPD/112547/2015 (C.M.C.) and Investigator FCT Contract CEECIND/00833/ 2017 (R.G.) as well POCH and European Union. Financial support from the Basque Government Industry and Education Departments under the ELKARTEK, HAZITEK and PIBA (PIBA-2018-06) programs, respectively, is also acknowledged.

References:

[1] J.M. Tarascon, M. Armand, Issues and challenges facing rechargeable lithium batteries, Nature, 414 (2001) 359-367.
[2] C.M. Costa, Y.-H. Lee, J.-H. Kim, S.-Y. Lee, S. Lanceros-Méndez, Recent advances on separator membranes for lithium-ion battery applications: From porous membranes to solid electrolytes. Energy Storage Materials 2019.
[3] J.C. Barbosa, J.P. Dias, S. Lanceros-Méndez, C.M. Costa, Recent Advances in Poly(vinylidene fluoride) and Its Copolymers for Lithium-Ion Battery Separators, Membranes 2018, 8, 45.

Testing and evaluation of battery technologies for commercial and residential applications in AGERAR project

E. López González(1), L. Fialho(2), L. Vargas Vázquez(1), A. Foles(2), J. Saénz Cuesta(1), M. Collares Pereira(2)

(1) Instituto Nacional de Técnica Aeroespacial (INTA), Área de Energías Renovables-CEDEA, Ctra. S.Juan-Matalascañas, km.34, 21130, Mazagón (Huelva), Spain

(2) Universidade de Évora, Cátedra Energias Renováveis, Casa Cordovil, Rua D. Augusto Eduardo Nunes, n.7, 7000-651, Évora, Portugal

Energy storage systems are key in the way towards decarbonization of the energy system. Different technologies coexist because their characteristics make them attractive to different applications. The AGERAR project (Storage and management of renewable energies in commercial and residential applications) aims to evaluate technical solutions to promote energy efficiency and sustainability criteria in commercial and residential micro grids. One of the activities of the project addresses the test, evaluation and comparison of main key performance indicators (KPIs) for different battery technologies, suitable for commercial and residential applications, from cells to complete systems up to 60 kWh. This validation provides reliable information to the public bodies, private companies and final users, based on experimental data, about the real performance and potential benefits of these technologies, in terms of efficiency, lifetime, costs, safety, etc. UÉvora is focused on commercial Li-ion based systems and Vanadium Redox Flow Batteries (VRFB), while INTA is testing Li-ion cells and packs with lithium titanium oxide (LTO) anode, as well as Al-ion cells. Preliminary results show the technical feasibility of LTO based Li-ion and VRF batteries for the commercial and residential applications considered in the project. In addition, other critical parameters must be considered for these applications, particularly the battery monitoring and management system (with cell balancing capabilities) and the power conditioning system. Regarding Al-ion batteries, the technology is very promising, mainly regarding cost and environmental issues, but an important effort is still mandatory to implement it in commercial and residential applications.

.

Application of carrageenans in lithium-sulfur batteries

Kamil Jaššo (1), Tomáš Kazda (1), Lifeng Liu (2), Bruno Xavier (2)

(1) BUT – Brno University of Technology, Department of Electrical and Electronic Technology, Technicka 10, 616 00 Brno, Czech Republic

(2) INL – International Iberian Nanotechnology Laboratory, Avenida Mestre José Veiga s/n, 4715-330 Braga, Portugal

Lithium-sulfur batteries (Li-S batteries or LSB) are currently among the most promising successors to Li-ion batteries. They are particularly promising thanks to their high theoretical capacity of 1673 mAh g^{-1} and low cost.[1] However, before deploying into the commercial sphere, it is necessary to solve a few shortcomings, especially shuttle effect, which is the primary cause of their failure. This so-called shuttle effect is caused by the dissolution of the discharge reaction intermediates (polysulphides) in the electrolyte and their subsequent migration and deposition on the metal lithium anode. So far, efforts to prevent polysulfide migration and deposition have focused mainly on the encapsulation of sulfur or forming an active filter layer on the electrode surface. However, according to many types of research, the binders have a great influence on the polysulfide migration and electrochemical properties of the Li-S cell.[2,3,4] This article focuses on the use of water-soluble, non-toxic organic binders in Li-S batteries. Carrageenans are linear sulfated polysaccharides prepared by alkaline extraction from red seaweed and are widely used in the food industry. There are various types of carrageenans, however, three main commercial classes are kappa, iota and lambda carrageenans, which differ mainly in number and position of the ester sulfate groups on the repeating galactose units. This paper deals with the influence of different types of carrageenan on the electrochemical properties of Li-S cells.

Authors gratefully acknowledge the financial support from the Ministry of Education, Youth and Sports of the Czech Republic under project No. LTT19001 and BUT specific research program (project No. FEKT-S-17-4595).

References:

[1] L. Chen and L. L. Shaw, Journal of Power Sources, 267, 770-783 (2014).
[2] M. Ling, L. Zhang, T. Zheng, J. Feng, J. Guo, et. al., Nano Energy, 38, 82-90 (2017)
[3] Z. W. Seh, Y. Sun, Q. Zhang and Y. Cui, Chem. Soc. Rev., 45, 5605-5634 (2016)
[4] J. Liu, Q. Zhang, and Y. Sun, Journal of Power Sources, 396, 19-32 (2018)

Manganese Sulfide Crystallites Development and Supercapacitor application

Mário Almeida [(a)], M. F. Montemor [(a)], T. M. Silva [(b)]

[(a)] Centro de Química Estrutural-CQE, DEQ, Instituto Superior Técnico, Universidade de Lisboa, Lisboa, Portugal

[(b)] ISEL-Instituto Superior de Engenharia de Lisboa, Instituto Politécnico de Lisboa, Lisboa, Portugal

Through a one-pot solvothermal synthesis method we were able to develop pure nanostructured tripods γ-MnS crystallites. γ-MnS structures show a specific capacitance value of 234.2 F g^{-1} at a current density of 1 A g^{-1}, with 52% charge retention ability at a high discharge current density of 10 A.g^{-1}, with specific capacitance of 121.6 F g^{-1}. The material has excellent charge retention ability with 81.2% capacitance retention after 5000 cycles. The results show promising electrochemical performance towards the application of γ-MnS crystallites in the development of supercapacitor energy storage solutions.

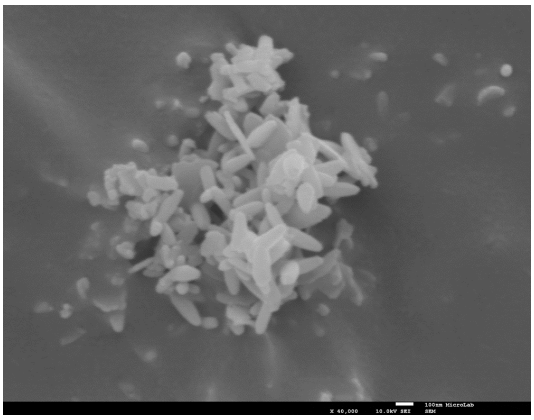


Figure 1 – *SEM image of nanostructured γ-MnS.*

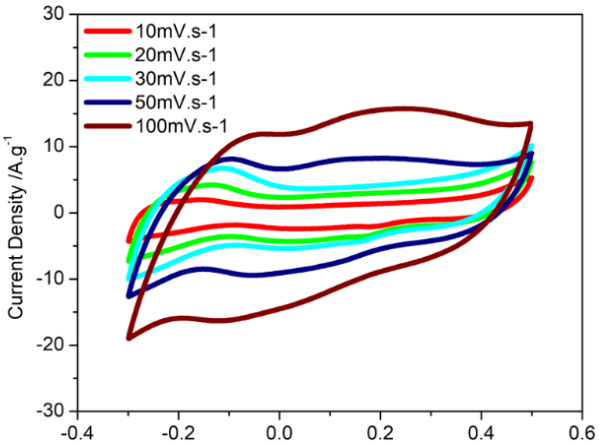


Figure 1 – *Cyclic Voltammetry at distinct speed rates of nanostructured γ-MnS electrode.*

We thank the financial support from PEGASUS - Plasma Enabled and Graphene Allowed Synthesis of Unique nanoStructures - an Horizon2020 FET-OPEN Grant Number: 766894

References:

[1] Tang, Y., Chen, T. and Yu, S. ; Chem. Commun., 2015, 51, 9018.
[2] Lei, S., Tang, K., Yang, Q. and Zheng, H., Eur. J. Inorg. Chem. 2005, 4124–4128

Improved lithium storage performance of Bi_2Se_3 electrode with effective surface modification via conductive coating

Rajesh Thomas [(1)], Sitaramanjaneya Mouli Thalluri [(1)], Bruno Xavier [(1)], Zhixin Tai [(1)], Nan Zhang [(1)], Ziyu Lu [(1,2)], Lifeng Liu [(1)]

(1) International Iberian Nanotechnology Laboratory (INL), Av. Mestre Jose Veiga, 4715-330, Braga, Portugal.
(2) School of Engineering and Technology, China University of Geosciences at Beijing, Beijing 100083, PR China.

In this work, we report a cost-effective method allowing for surface coating of titanium oxide on Bi_2Se_3 nanoplates (TiO_2@Bi_2Se_3), which was synthesised via a hydrothermal method. A reversible specific capacity of 512 mAh/g was obtained for TiO_2@Bi_2Se_3 electrodes at the current density of 100 mA/g, with an initial coulombic efficiency of 92%, whereas the bare Bi_2Se_3 electrode shows a smaller reversible specific capacity of 506 mAh/g and a substantially lower initial coulombic efficiency of 78%. Moreover, TiO_2@Bi_2Se_3, compared to the bare Bi_2Se_3 exhibits significant improvements in rate performance and cycle stability as shown below in **Figure1**. The capacity drastically decreases upon cycling for bare Bi_2Se_3 electrode, while for the TiO_2@Bi_2Se_3 electrode, the decrease in capacity is insignificant. This work demonstrates a viable route to design electrode materials with both excellent rate and cyclic performance for Li-ion storage.

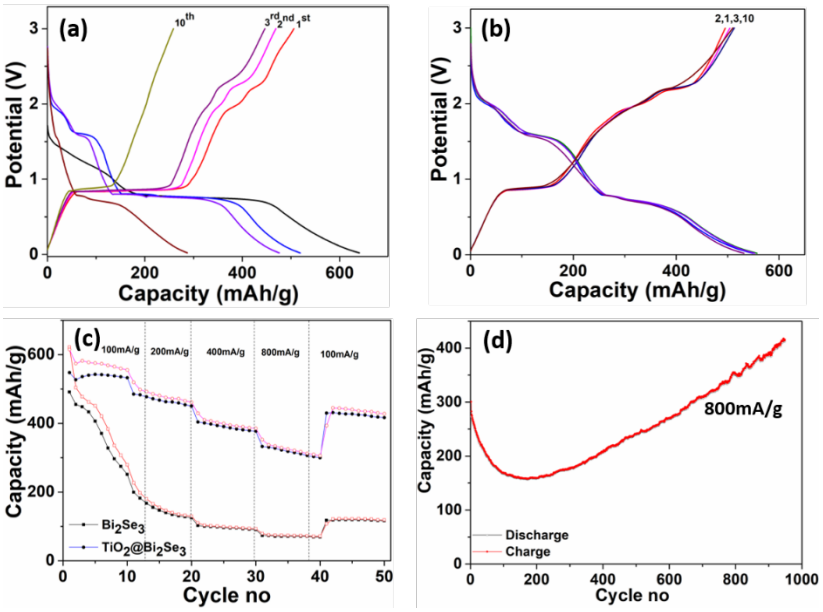


Figure 1 *Charge discharge profile of* Bi_2Se_3 (a) and TiO_2@Bi_2Se_3 (b) electrodes and *rate performance (c)* of both electrodes; and (d) Cycle stability of TiO_2@Bi_2Se_3 electrode.

Acknowledgement: The authors acknowledge the project "Nanotechnology Based Functional Solutions" (NORTE-01-0145-FEDER-000019), supported by Norte Portugal Regional Operational Programme (NORTE2020), under the Portugal 2020 Partnership Agreement through the European Regional Development Fund (ERDF), as well as the financial support from Fundação para a Ciência e a Tecnologia through FCT-UT Austin project (MePhEES, UTAP-EXPL/CTE/0008/2017).

High-shear exfoliation technology to produce ultrathin 2D nanosheets for high capacity and long-life alkali-ion batteries

Zhixin Tai[1,2], Yajie Liu[1,2], Zhe Hu[2], Shulei Chou[2], Zaiping Guo[2], Huakun Liu[2], Shixue Dou[2]

(1) Institute for Superconducting and Electronic Materials, Australian Institute for Innovative Materials, University of Wollongong, Wollongong, Australia

(2) International Iberian Nanotechnology Laboratory, Braga, Portugal

Two-dimensional (2D) materials have various unique physical and chemical properties, which have prompted widespread applications in the fields of catalysis, nanoelectronics, energy storage and conversion, etc. In particular, 2D materials show substantial promise for use as electrode materials in energy storage and conversion due to their high accessible surface area and fast charge transfer kinetics, so that they are proposed to be able to significantly enhance the rate performance of electrodes. In this presentation, we report a high-shear exfoliation mechanical technology, which enables us to develop a series of 2D electrode materials for use in alkali-ion (Li^+, Na^+, and K^+) batteries. The transformation of the bulk crystals into monolayer or few-layer flakes and the chemical reaction of the solvent during the high-shear exfoliation have been comprehensively studied. Our electrochemical tests demonstrate that the as-synthesized 2D nanosheets show the high energy storage capacity and interesting electrochemical behaviours for alkali-ion storage. The research would open up a new avenue to the next-generation long-life and high-rate secondary ion batteries.

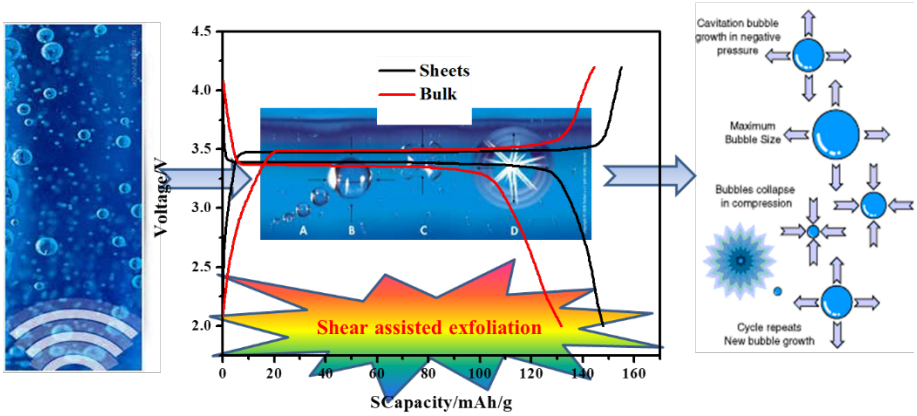


Fig.1 High-shear exfoliation technology to produce ultrathin 2D nanosheets for high capacity and long-life alkali-ion batteries

Acknowledgement: Auto CRC 2020 project; Australian Research Council (ARC) Linkage Project (LP120200432), Infrastructure, Equipment and Facilities (LIEF) grant (LE0237478); National Natural Science Foundation of China (Grant No. 61504055), and Natural Science Foundation of Hunan Province (Grant No. 2015JJ3110)

References:

[1] Z Hu, Z.X. Tai, Q.N. Liu, S. W. Wang, H.L. Jin, S. Wang, W.H. Lai, M.Z. Chen, L. Li, L.N. Chen, Z.L. Tao, S.L. Chou, Advanced Energy Materials, 9, 1803210, 2019.
[2] Y.J. Liu, Z.X. Tai, J. Zhang, W.K. Pang, Q. Zhang, H.F. Feng, K. Konstantinov, Z.P. Guo, H.K. Liu, Nature Communication, 9(1), 2018.
[3] Z.X. Tai, C.M. Subramaniyam, S.L. Chou, L.N. Chen, H.K. Liu, S.X. Dou, Advanced Materials, 29(34), 1700605, 2017.

Tips-covered anode achieving uniform lithium deposition for stable lithium metal batteries

Ziyu Lu[(1) (2)], Zhixin Tai[(1)], Rajesh Thomas[(1)], Zhijian Peng[(2)], Lifeng Liu[(1)]

(1) International Iberian Nanotechnology Laboratory (INL), Braga 4715-330, Portugal

(2) School of Engineering and Technology, China University of Geosciences at Beijing, Beijing 100083, PR China

Energy storage using lithium (Li) metal has been regarded as “Holy grail” for the next high-energy secondary batteries due to Li’s extremely high specific capacity of 3860 mAh g^{-1}. However, the growth of dendrite and huge volume change during repeated Li plating/stripping processes cause Li metal batteries to fail rapidly. Since the high chemical and electrochemical reactivity of Li, the dendrite preferentially starts to grow at active points, such as tips, kinks and defects at the inhomogeneous interface, because these points can easily accumulate abundant electric charges and then strongly attract lithium ions to form nucleus. To address these issues, we prepared a special composite structure, by growing a layer of non-conductive PAN nanofibers using electrospinning onto the top of vertically aligned copper (Cu) nanowires with an aim to suppress the preferential growth of Li dendrites. Due to the strong dependence of electrical fields in the electrospinning process, the tips of Cu nanowires are mostly covered by PAN nanofibers. Simultaneously, this 3D structure also dissipates the high current density to homogenize Li-ion flux, which further enables uniform lithium deposition. On this basis, stabilized cycling behaviour and excellent rate performance are achieved, highlighting the feasibility of the proposed Li anode composite.

References:

[1] Cheng XB, Zhang R, Zhao CZ, Zhang Q, Toward safe lithium metal anode in rechargeable batteries: a review, Chemical Reviews, 117(15), 10403-73 (2017).

[2] Lin D, Liu Y, Cui Y, Reviving the lithium metal anode for high-energy batteries, Nature Nanotechnology, 12(3), 194-206 (2017).

[3] Yang CP, Yin YX, Zhang SF, Li NW, Guo YG, Accommodating lithium into 3D current collectors with a submicron skeleton towards long-life lithium metal anode, Nature Communications, 6, 8058 (2015).

Plasma assisted sponge-like carbon coating towards stable lithium anode

Ziyu Lu[(1) (2) (3)], Zhenggang Zhang[(2)], Sudong Wu[(2)], Zhe Peng[(2)], Jichun Ye[(2)], Zhijian Peng[(1)]

(1) School of Engineering and Technology, China University of Geosciences at Beijing, Beijing 100083, PR China

(2) Ningbo Institute of Materials Technology and Engineering, Chinese Academy of Sciences, Ningbo 315201, PR China

(3) International Iberian Nanotechnology Laboratory (INL), Braga 4715-330, Portugal

Energy storage using lithium (Li) metal has been regarded as “Holy grail” for the next high-energy secondary batteries due to Li’s extremely high specific capacity of 3860 mAh g^{-1}. However, the growth of dendrites and huge volume change during repeated Li plating/stripping processes cause Li metal batteries to fail rapidly. To address these issues, a special porous composite anode has been prepared by growing a uniform sponge carbon coating onto carbon paper via the plasma method. Due to its low electronic conductivity and compact structure of sponge-like carbon layer, lithium atoms are able to controllably deposit into the 3D matrix of carbon paper, which effectively suppress the dendrite growth and volume change. Those lead to a high coulombic efficiency of 98-99% at a high capacity of 3-4 mAh cm^{-2} in corrosive carbonate electrolyte. Moreover, Li-$LiFePO_4$ cells could keep a high capacity retention of 89.4% after 650 cycles. Our results clearly demonstrate the feasibility of the proposed sponge-like carbon coating, which could be applied in lithium metal anode for stable batteries’ performance.

References:

[1] Winter M, Barnett B, Xu K, Before Li Ion Batteries, Chemical Reviews, 118(23), 11433-56 (2018).
[2] Cheng XB, Zhang R, Zhao CZ, Zhang Q, Toward safe lithium metal anode in rechargeable batteries: a review, Chemical Reviews, 117(15), 10403-73 (2017).
[3] Lin D, Liu Y, Cui Y, Reviving the lithium metal anode for high-energy batteries, Nature Nanotechnology, 12(3), 194-206 (2017).

https://nanoGateway.eu/en/mission-batteries/

mission 1000

conference

Conference Organizer:

INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY