THEME 2 : CHEMISTRY FOR ENERGY AND RESOURCES

Symposium 2.1 : Materials for Energy by Computational Design

The use of computational techniques has tremendously impacted materials chemistry in the last decades. A notable shift is from primarily using these approaches to understand fundamental materials properties to true predictions and design of new materials. This symposium will focus on these recent developments including new techniques such as crystal structure prediction or high-throughput approaches with an emphasis on energy related applications from Li-ion batteries, to porous materials and photovoltaics.

Keywords
ab initio computation, high-throughput screening, battery materials, electrocatalysis, big data, functional materials, photovoltaics, porous materials, crystal structure prediction, metal-organic frameworks,

Organizers:

- *Caroline MELLOT-DRAZNIEKS (Collège de France, Paris, FR)*
- *Geoffroy HAUTIER (UCL, Louvain, BE)*

Session 2.1.1: New computational approaches to materials design

Abstract:

The search and design of new materials using ab initio technique has been strongly impacted by the emergence of new approaches based on large database/high-throughput searches as well as new structure prediction techniques. These techniques drastically reduce the time needed to invent new materials by focusing experiments on compounds that show the most promise computationally while allowing reaching a level of understanding never achieved so far in terms of the physics and chemistry of materials.

Keywords

New materials, high throughput screening, big data, crystal structure prediction

Speakers:

- THL: Peter BRUCE (Oxford, UK)
- KN: Kristin PERSSON (UCAL Berkeley, USA)
- IL1: Yanming MA (Jilin University, CN)

Session 2.1.2: Computational design of materials for energy storage and electrocatalysis

Abstract:

New theoretical and experimental methods towards accelerated computational screening, reaction network modeling and targeted materials synthesis currently play an unprecedented role in materials science and heterogeneous catalysis with the discovery of new and more efficient solids for storage or catalysis. The detailed understanding of atomic scale scaffolds and chemical processes when combined with the elucidation of key descriptors may dictate the discovery process while allowing anticipating essential thermodynamics and kinetic features. This session will aim at highlighting how computational design has majorly stepped in the area of catalysis (including electrocatalysis and photocatalysis) and energy storage, ranging from metal transition surfaces to porous solids, along a large range of adsorption-storage processes or catalytic reactions of interest to energy (CO_2 /CH_4 storage, CO_2RR, HER, OER etc. . .)

Keywords

Energy storage, battery materials, electrocatalysis, thermodynamics and kinetics descriptors

Speakers:

- KN: Philippe SAUTET (ENS, Lyon, FR; CBE-UCLA, USA)
- IL1: Berend SMIT (EPFL, Lausanne, CH)
- IL2: Rochus SCHMID (University of Bochum, DE)

Session 2.1.3: Computational design of photovoltaic and functional materials

Abstract:

Understanding the electronic structure of molecules or materials is the key to the control of their properties and their application as semiconductors in photovoltaic, magnetic, optical, and ferroic materials etc . . . This requires combining experiments tightly with numerical modeling and device studies. This session will cover the recent advances in the understanding and computational prediction of electronic properties at the atomic scale in the search of functional materials.

Keywords

Photovoltaics, electronic properties, functional materials

Speakers

- KN: Jenny NELSON (Imperial College, London, UK)
- IL1: Michael HAYWARD (Oxford University, UK)
- IL2: James RONDINELLI (Northwestern University, Evanston, USA)

Symposium 2.2: New approaches for electrochemical energy storage and conversion systems

Development of efficient energy storage strategy is one of the key steps toward the success of the emerging electric vehicle industry (including buses, trams…) and the large-scale energy storage systems for the renewable energy utilizations. Current lithium-ion battery chemistry has served as one of the most important options, however, the limitations with respect to the energy/power density, cost and cycle life still need to be addressed. Similarly, improving the energy density of supercapacitors is one of the key challenges for this technology. Novel approaches encompassing new battery / supercapacitor chemistries and concepts are thus needed. This session will present state-of-the-art and innovative approaches in developing new materials and chemistries for energy storage applications.

Keywords:
energy storage materials/systems, rechargeable batteries, electrode, post lithium-ion battery chemistry, material design, multi-valent ion batteries, supercapacitors

Organizers:

- *Kisuk KANG (Seoul National University, KR)*
- *Patrice SIMON (Université Paul Sabatier Toulouse-III, FR)*

Session 2.2.1: New chemistries for batteries

Abstract*:*

Lithium rechargeable batteries have served as one of the most important power sources in portable electronic devices for past decades. For emerging large-scale applications, however, the current lithium battery chemistry has to be further improved with respect to the energy/power/cost/stability, which requires the breakthrough progress in the technology or new battery chemistry beyond lithium. This session will focus on the relevant recent progress in this regard.

Keywords:
New electrolyte systems, post LIB chemistry, Na-ion batteries and multi-valent ion batteries, binders, novel tools for battery characterizations, high-energy electrode.

Speakers

- KN: Atsuo YAMADA (University of Tokyo, JP)
- IL1: Jang Wook CHOI (Seoul National University, KR)
- IL2: William CHUEH (Stanford University, USA)

Session 2.2.2: New concepts for electrochemical capacitors

Abstract:

Electrochemical capacitors have been extensively studied during the past decade. Fundamental studies of the physical mechanism underlying charge storage in capacitive and pseudocapacitive materials, as well as the development of in-situ tools and advanced simulation techniques have led to performance improvement. This session will present the recent advances in the field, focusing onto new concepts for capacitive and pseudocapacitive energy storage, including new concepts of electrolytes.

Key words:
carbon, porous materials, 2-dimmensional materials, metal oxides, metal carbides electrolytes, electrode architecture, in-situ and advanced characterization techniques.

Speakers:

- KN: Bruce DUNN (MSE, UCLA, USA)
- IL1: Katsumi KANEKO (ICST, Shinshu University, Nagano, JP)
- IL2: Andrea BALDUCCI (CEEC, Jena University, DE)

Session 2.2.3: New materials for energy storage

Abstract:

New material discovery is the essential step for the breakthrough advancement of current lithium ion batteries and supercapacitors technology. Various approaches have been taken to explore new materials from computational design to combinatorial experimental screening. This session presents recent findings on promising new materials from these efforts.

Keywords:
Lithium ion batteries, pseudocapacitive materials, electrode materials, material design, material synthesis, computational prediction, combinatorial material screening, electrolyte, separator.

Speakers:

- KN: Gerbrand CEDER (UCAL Berkeley, USA)
- IL1: Yong Sheng HU (Institute of Physics, Beijing, CN)
- IL2: Yuri GOGOTSI (Drexel University, Philadelphia, USA)

Symposium 2.3: Turning solar energy to fuels via artificial photosynthesis

On the path to an energy transition away from fossil fuels to sustainable sources, scientific breakthroughs must be achieved. One main objective is to produce solar fuels from solar energy and water to accomplish the efficient storage of solar energy in a chemical form. This is a grand scientific challenge. One important approach to achieve this goal is Artificial Photosynthesis, a discipline which nowadays gathers materials science (Photo-Electro-Chemical processes), molecular sciences (antenna systems, light-driven electron transfers and bio-inspired catalysts) and biological sciences (photosynthesis and multi-electron metallo-enzymes) through the use of common concepts (light harvesting, electron transfer, electrocatalysis, reaction mechanisms) and tools (nanosciences, electrochemistry, photochemistry, advanced spectroscopy and theoretical chemistry).
This 2.3 symposium is divided into three sessions, each dedicated to one of the main approaches of solar fuels production:

- the first one will deal with advances in multi-electron multi-proton electrocatalysis (H_2 evolution, CO_2 reduction, water oxidation…) including mechanistic studies and operando measurements
- the second one will address the challenge of designing cheap, efficient and stable direct solar energy conversion into chemicals in Photoelectrochemical cells
- the third one will be dedicated to molecular and biomolecular approaches of artificial photosynthesis.

Keywords:

Electrocatalysis, fuel forming reactions, photocatalysis, photonics, solid-liquid interface, electron transfer, device-physics modelling.

Organizers:

- *Shane ARDO (UCAL Irvine, USA)*
- *Peter STRASSER (TU Berlin, DE)*
- *Vincent ARTERO (CEA Grenoble, FR)*

Session 2.3.1: Multi-electron multi-proton electrocatalysis

Abstract*:*

In artificial photosynthesis, photogenerated free electrons and free holes unfold their reactive power through “dark”, that is, not light-driven, but bias potential-driven electrochemical transformations. Molecular fuel bonds are generated by means of heterogeneous electrocatalytic bond making and breaking at a liquid electrolyte-solid electrocatalyst interface. This Session addresses the surface chemistry and surface reactivity of such electrocatalytic processes at the atomic scale. Topics covered include synthesis, operando characterization of catalysts and reactive intermediates and concomitant electrochemical performance.

Keywords:
Electrocatalysis, Fuel forming reactions, interfacial electron-transfer, operando, X-ray characterization, in-situ techniques, CO2 reduction, Oxygen Evolution.

Speakers:

- KN: Beatriz ROLDÁN CUENYA (Fritz Haber Institut Max Planck, Bochum, DE)
- IL1: Ifan E. L. STEPHENS (Imperial College, London, UK)
- IL2: Fabio DIONIGI (TU Berlin, DE)

Session 2.3.2: Direct solar energy conversion photoelectrochemical cells

Abstract:

State-of-the-art solar fuels constructs absorb sunlight, separate electronic mobile charge carriers, and use them to directly drive fuel-forming redox reactions at semiconductor–liquid junctions. These integrated assemblies require exquisite control over various aspects of light-driven redox chemistry, including photon management, selective contacts for electronic charge separation, charge accumulation at redox-active electrocatalytic sites, multiple-electron/proton-coupled reactions, chemical species transport, ionic conduction, thermal effects, and mitigation of chemical crossover. This session will highlight the latest advances in understanding and controlling these complex coupled phenomena.

Keywords:

Photoelectrochemistry, photocatalysis, solar thermochemistry, semiconductor-liquid junctions, electrocatalysts, operando characterization, membrane separators, transport processes, device-physics modeling, numerical simulations, nanoparticles, nanowires, nanocrystals, photonics, artificial leaf, bionic leaf.

Speakers:

- KN: Peidong YANG (UCAL Berkeley, USA)
- IL1: Sophia HAUSSENER (EPFL, Lausanne, CH)
- IL2: Lilac AMIRAV (Technion, Haifa, IL)

Session 2.3.3: Molecular approaches for solar fuels generation

Abstract*:*

Photosynthesis allows plants and algae to convert solar energy into fuels. This is made possible thanks to a complex and well-organized molecular machinery involving enzymes, photosystems and various cofactors. Artificial photosynthesis aims at reproducing this process through the development of hybrid systems combining synthetic bio-inspired compounds,

biomolecules and/or extended inorganic compounds and their integration into photoreactors or photoelectrochemical cells.

Keywords:

Dye-sensitized photoelectrochemical cells; electro-assisted catalysis, interfacial electron-transfer, photocatalysis; antenna effects, photosystems; hydrogenases, charge photoaccumulation.

Speakers :

- KN: Erwin REISNER (University of Cambridge, UK)
- IL1: Elisabeth GIBSON (University of Newcastle, UK)
- IL2: Osamu ISHITANI (Tokyo Institute of Technology, JP)

Symposium 2.4: Toward multi-terawatt clean photovoltaic energy conversion – grand chemical challenges

Since 1954 photovoltaics (PV) has moved from a negligible contribution in the energy supply to a significant level (12.1% of electricity in Germany in April 2018 for example), mostly based on silicon wafer technologies and representing about 415 GWp installed in the world. To reach the multi TW scale, disruptive scientific innovations are needed in addition to incremental improvements of present technologies and concepts. Increasing the conversion efficiencies beyond the Shockley-Queisser-Limit by innovative concepts or architectures such as multijunctions, reducing the cost of production by innovative technologies and processes, reducing the carbon footprint and grey energy by low cost and abundant materials and finally driving down the electricity costs from PV to a few eurocents per kWh, are exciting challenges for all researchers worldwide. A key point of the development of disruptive PV is that it involves at an unperceived level chemical sciences and concepts. Developing next generations of photovoltaic devices at the multiTW scale is thus a Grand Chemical Challenge. The symposium will serve as an active platform for researchers to bring into light the state of the art and new contributions of chemistry in the field of disruptive photovoltaics that can reach TW of installed power.

Keywords:
organic solar cells, Si-based solar cells, inorganic solar cells, hybrid perovskite solar cells, dye sensitized solar cells, quantum dot solar cell, solar energy conversion, thin film solar cells, tandem solar cells, plasmonic, photon conversion, interfacial design, stability, durability, high efficiency.

Organizers:

- *Negar NAGHAVI (CNRS/ E2P2L, Shanghai, CN)*
- *Moritz RIEDE (Dpt of Physics, Oxford University, UK)*
- *Teodor TORODOV (IBM, T. J. Watson Research Center, Yorktown Heights, NY, USA)*

Session 2.4.1: Next generation of Hybrid Perovskites and earth-abundant materials solar cells

This session focuses on the latest scientific and technical progress of perovskites, kesterites and other emerging earth abundant photovoltaic absorbers. This session will cover the main aspects of the science of materials and devices that are paving the road towards the high efficient and stable solar cells. Topics concerning materials synthesis, device physics, modeling, novel n and p-type transparent conducting oxides, defects analysis of materials, Interface and surface properties, degradation mechanisms and strategies to improve cell performance and lifetime and any related issues will be discussed.

Keyword: Hybrid perovskites solar cells; kesterites, emerging earth abundant solar absorbers, defects analysis, interface and surface properties, reproducibility, stability, degradation mechanisms, life cycle analysis

Speakers:

- KN: David MITZI (Duke University, Durham, USA)
- IL1: Sang-Il SEOK (UNIST, Ulsan, KR)
- IL2: Hema KARUNADASA (Stanford University, USA)

Session 2.4.2: Organic, dye sensitized and new concept based solar cells

Abstract:

Organic and dye sensitized solar cell devices have attracted a significant attention in scientific community due to their potential to scale to terawatt and becoming a triple-green technology: green manufacturing with clean processes and non-toxic materials, clean electricity supply during solar cell operation, and finally – closing the loop – with a recycling scheme available for the used materials.. This session will be focused on materials development for these solar cell technologies, including material synthesis of polymers and small molecules, as well as new device architectures and device characterization, manufacturing and up-scaling technologies and strategies and stability and degradation mechanisms for these solar cell technologies. It includes material synthesis of polymers and, small molecules, as well as, new device architectures and device characterization, and emerging PV technologies (including new concepts like quantum dot solar cells, photon conversion…).

Keywords:

Organic solar cells, dye sensitized solar cells, emerging PV technologies, stability, degradation mechanism, charge generation and recombination, manufacturing and up-scaling

Speakers:

- **Symposium Honorary Lecture**:
  THL: Michael GRAETZEL (EPFL, Lausanne, CH)
- KN: Natalie STINGELIN (Imperial College, London, UK)
- IL1: Martin PFEIFER (Heliatek GmbH, Dresden, DE)
- IL2: Thuc-Quyen NGUYEN (UCSB, Santa Barbara, USA)

Session 2.4.3 : High efficiency based solar cells and modules from established market technologies (Si, chalcogenide and III-V based materials).

Abstract:

Today's world wide PV market is dominated by the crystalline silicon technology (>90 %). The remainder is based on thin film solar cell technologies and consists mainly of based thin film CdTe, $Cu(In,Ga)(S,Se)_2$ (CIGSSe), and amorphous Si solar cells. The competitiveness of a photovoltaic module is largely determined by the cost per unit power output. While thin film solar cells have the potential for low cost production, Si based solar cells have shown important price reduction during the last years. This subarea aims to bring together actors on these different technologies and to provide a platform for presenting recent and on-going researches for further efficiency improvements and cost reduction employing novel carrier-selective passivating contact schemes, light management, interfacial optimization and tandem multi-junction architectures, in particular those that combine silicon absorbers with organic or inorganic materials such as perovskite.

Keywords:

Silicon, CdTe, CIGS, III-V solar cells and modules, textures, surface passivation, metallization, light management, new processes and materials for junction formation, Tandem devices (e.g. perovskite on c-Si, CIGS/perovskite, Si-III V, etc), Advanced modelling and characterization techniques, Flexible solar cells

Speakers:

- KN: Stefan GLUNZ (ISE Fraunhofer, Freiburg, DE)
- IL1: Marika EDOFF (Uppsala University, SE)
- IL2: David CAHEN (Weizman Institute of science, Rehovo, IL)

Symposium 2.5: Management of Renewable Energy Related Materials Resources

Joint Symposium of the themes *"Chemistry for Environment"* and *"Chemistry for Energy and Resources"*

Among the 17 sustainable development goals (SDG), adopted by the UN 70th general assembly in December 2015, SDG 7 "Ensure access to affordable, reliable, sustainable, and modern energy for all", SDG 12 "Ensure sustainable consumption and production patterns" and SDG 13 "Urgent action to combat climate change" can be translated into the problem of an optimal management of natural resources in energy and raw materials.

Our planet faces formidable energy challenges, but great hopes are placed on the use of renewable energies such as wind, wave and sun which can generate huge amounts of electricity. The increasing deployment of photovoltaic/wind farms, of electrochemical energy storage units and of transition lines will call for huge amounts of materials. This triggers severe concerns about materials availabilities and global reserves, and raise questions about recycling. Life Cycle Analysis (LCA) studies will undoubtedly become more important in the next decades. Chemical elements of interest are i) 4d and 5d transition metals of groups 8 to 10 used in catalysis for energy production as well as depollution, ii) rare earths used in electronic components and magnets, and iii) elements used in mobile and stationary batteries. Noble gases, and particularly He are of increasing technological importance, while known sources and reserves are quite limited and geographically scarce.

A special focus will be given on the increasing use of H_2 as a pillar of this global energy challenges, more and more called "the hydrogen economy". Hydrogen will be an energy vector and a starting chemical resource massively produced from renewable and intermittent electricity (sun, wind, tides…) as "power to gas" or "power to chemicals" concepts. Such approaches will allow a better match between a day to day and inter-seasonal offer and demand. Advances in earth abundant materials involved in H_2 production by electro-catalytic, photovoltaic or photo-catalytic water splitting, should therefore be considered. Besides H_2 produced from solar energy, natural hydrogen sources [1] might significantly contribute to the energy landscape. This symposium should also allow review the questions related to origins and reserves, geological contexts, fluxes and exploitation strategies of natural H_2. A fresh geochemical look at this problem is very relevant, all the more as natural H_2 sources have been identified with significant concentrations in He.

This symposium will therefore call for original researches showing i) the multifaceted aspects of chemical recovery processes of energy-related materials so as to revitalize the image of "recycling chemistry", too frequently associated to an old and boring chemistry, ii) the development of models to forecast the worldwide materials reserves under various scenarios, iii) novel LCA models to predict which development scenario is the most sustainable, iv) contributions covering geochemical, extractive and processing aspects of renewable energy-related material resources, v) novel energy storage or catalytic materials involving earth abundant elements, vi) essential rare elements savings, towards the concept of "oligo-elements for energy conversion", like oligo-elements are involved in biological functions, which is also a solution to manage the resources in a sustainable way.

[1] V. Larin et al., Natural Molecular Hydrogen Seepage Associated with Surficial, Rounded Depressions on the European Craton in Russia, Natural Resources Research, 24(3), 369-383 (2015) [DOI: 10.1007/s11053-014-9257-5, Published online November 15, 2014].

Keywords:

Hydrogen, energy, geochemistry, recovery, recycling, substitution of rare elements, life cycle analysis, batteries, fuel cells, electrolysis, oligo-elements for energy conversion.

Organizers:

- *Thierry LEMERCIER (Solvay, Brussels, BE)*
- *Elsa OLIVETTI (Dept of Materials Science and Engineering, MIT, Cambridge, USA)*
- *Alain PRINZHOFER (GEO4U/BR, IPGP Paris, FR)*

Session 2.5.1: New materials for green energy production

Abstract:

Available and affordable energy is today a key challenge for humanity. The confirmation that global warming is due to the increase of greenhouse gases in the atmosphere, together with the uneven global distribution of energy sources, requires drastic changes in the way we generate and supply energy. To deal with those challenges it is needed to develop innovative strategies to reduce the costs of generating energy from renewable sources, and develop greener, cheaper and scalable technologies for energy production and storage. Moreover, these technologies must rely on earth-abundant and recyclable materials selected according to their entire life-cycle impact, as well as on clean and affordable processes, to ensure long-term sustainability.
New materials for green energy can play a role on different levels: as building blocks of renewable energy production devices (Photovoltaic, Windmill…) or of energy storage modules (batteries, capacitors), as catalysts for renewable and sustainable fuel production, as key element for energy saving by energy conversion (Thermoelectricity etc).
This session will then be dedicated to those challenges and will provide insights in new materials for green energy (including raw materials availability and costs dimensions) such as recycling processes of those materials with presentations of successes and challenges.

Keywords:

Materials for green energy production, global resources, recycling, metals

Speakers:

- KN: Daniel G. NOCERA (Harvard University, USA)
- IL1: Evi PETAVRATZI (British Geological Survey, Keyworth, UK)
- IL2: Christian HAGELÜKEN (UMICORE, Brussels, BE; Hanau, DE)

Session 2.5.2: Hydrogen economy

Abstract:

The place of hydrogen in the energetic transition is a widely discussed issue and has taken an increasing important role, but mostly as an energy vector. Recently, hydrogen has been mentioned as a mean for electricity storage in parallel to the growing demand of sustainable electricity production from hydroelectricity, solar or wind power which need to be stored because of present transient consumption supply and demands. So far, the best storage, in terms of efficiency, is the transformation of electricity into hydrogen by electrolysis and the transformation of hydrogen into electricity with fuel cells. In the world, manufactured hydrogen for chemical applications (ammoniac synthesis and petrochemistry) already represents a 100 billion dollars global budget, and an equivalent of 22% of the produced natural methane gas (in volume). However, production costs remain high. Moreover, when generated from fossil fuel energies, which financially may be considered the least expensive, its environmental impact and cost are non-negligible. When generated from electrolysis, which may be considered as “green” hydrogen, its financial cost is even higher.
The recent assessment of natural hydrogen in continental areas, sheds a new perspective to consider it as a supplementary source of energy, in addition to the main vectors of chemical production. Subsurface deep kitchens of hydrogen source are actively being studied. More superficial accumulations are located in specific geological contexts and, in some cases, not so remote from urban development areas, which may facilitate its valorization. Naturally sourced hydrogen in continental context has been found to be associated with noble gas helium, whose concentrations may reach 2-3%, higher than any known gas field where helium is produced today. So far, only minor pilot hydrogen industrial projects exist in Mali (West Africa) and in the United States, but most recently, substantial discoveries of hydrogen seeps have been reported in Russia, Canada and Brazil and may highlight a natural source of hydrogen for future World exploitation.

Keywords:

Hydrogen economy, hydrogen natural, industrial hydrogen

Speakers:

- KN: Isabelle MORETTI (ENGIE, Paris, FR)
- IL1: Régis RÉAU (Air Liquide, Jouy-en-Josas, FR)
- IL2: Chris BALLENTINE (Geochemistry, Earth Sciences, Univ. Oxford, UK)
- IL3: Eric DEVILLE (Geosciences, IFPEN, Rueil-Malmaison, FR)

Symposium 2.6: Chemistry and nuclear energy

Chemistry has been necessary to the development of nuclear energy in the early phases, from mining activities to final waste confinement; solvent extraction technologies have been boosted by nuclear industry, and now, it appears that chemistry could be an essential tool for facing its tomorrow's challenges. So called "generation IV" nuclear systems should be based on systematic and enhanced separation processes for both efficient recycle of valuable elements and drastic decrease of waste long-term harmfulness; innovative cladding materials for nuclear fuels could offer drastic improvement of safety features; and on-line liquid fuel treatment for molten salts reactors could pave the way for quite new nuclear systems…
This 2.6 symposium is divided into three sessions, each dedicated to one of the main nuclear issues concerned by chemistry:

- the first one will deal with advances in fuel cycle processes (industrial records, routes for improvement, main scientific challenges);
- the second one will address the today very tough issue of final waste management;
- the third one will be dedicated to possible break-through in materials and nuclear systems, focusing research today for possible industrial applications in the future).

Keywords:

Nuclear fuel cycle, uranium mining, uranium enrichment, nuclear fuel fabrication, nuclear fuel recycling, nuclear waste, long term safety, radioelements chemistry, innovative nuclear systems, thorium fuel cycle, innovative materials for nuclear reactors.

Organizers:

- *Bernard BOULLIS (French Atomic Energy & Alternative Energies Commission, FR)*
- *Patricia PAVIET (Office of Nuclear Energy, Department of Energy, USA)*
- *Mingzhang LIN (University of Science and Technology of China , CN)*

Session 2.6.1 : Fuel cycle processes

Abstract*:*

Chemistry and chemical engineering have been from the beginning involved in the development of nuclear systems, and sophisticated processes have been designed and operated, coping with the very severe requirements inherent to the nuclear field. It appears now that fuel cycle processes are key for the sustainability of nuclear industry: security of uranium supply, long-term management of nuclear materials and waste are directly linked to fuel cycle options and to fuel cycle processes. This session will provide a large overview of nuclear fuel cycle stakes, options and challenges for the future of nuclear power.

Keywords:
Nuclear fuel cycle, front-end, back-end, uranium mining, uranium enrichment, nuclear fuel fabrication, nuclear fuel recycling, plutonium management, innovative processes, radioelements chemistry, chemical separation, solvent extraction, chemical engineering for nuclear applications.

Speakers

- KN : Guillaume DUREAU (Executive VP, ORANO, Paris, FR)
- IL1: Terry A. TODD (Idaho National Laboratory, Idaho Falls, USA)
- IL2 : Guoan A. YE (China Institute of Atomic Energy, Beijing, CN)

Session 2.6.2: Nuclear waste management

Abstract*:*

Nuclear waste management is seen as one of the major issues that nuclear industry has to face in the next decades; design of appropriate materials for radioactive compounds confinement, (very) long term chemical behavior of radionuclides within the geosphere and the biosphere are important issues for the design of sustainable answers. This session will present state-of-the-art, innovative materials development and challenges in this area.

Keywords:

Nuclear waste, used fuel, nuclear glasses, nuclear ceramics, long term behavior, geological deep repository, long term safety, radionuclides migration, radioelements chemistry …

Speakers

- KN: Xiaolin L. WANG, (Chinese Academy of Engineering Physics, Sichuan, CN)
- IL1: Patricia Paviet (Pacific Northwest National Laboratory, USA)
- IL2: Sophie Schuller (CEA,FR)

Session 2.6.3: Innovative nuclear systems

Abstract*:*

Many innovative systems have been proposed within the recent past years, as attempts to build more efficient, safer and long-lasting nuclear systems. Chemistry is at the heart of most of them: molten salts reactors, thorium-based reactors, have to overcome new chemical challenges and/or material issues, which focus today an increased attention across the world. This session will present an overview of innovative concepts and related chemical challenges.

Keywords:

Innovative nuclear systems, molten salt nuclear reactors, thorium fuel cycle, pyro-processes, innovative materials for nuclear reactors, nuclear fuel, nuclear cladding materials.

Speakers

- KN: Fiona RAYMENT (Director, Nuclear Innovation and Research Office, UK)
- IL1 : David Hoezler (Oak Ridge National Laboratory, USA)