ΙΤΕ/ΕΙΧΗΜΥΘ

ΔΙΑΛΕΞΕΙΣ
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ΟΜΙΛΗΤΗΣ: **Professor Mohamed Eddaoudi**
Advanced Membranes and Porous Materials Center
King Abdullah University of Science and Technology (KAUST)
Thuwal, Saudi Arabia

ΘΕΜΑ: **Metal-organic materials: Strategies toward functional nanoporous materials**

ΤΟΠΟΣ: Αίθουσα σεμιναρίων ΙΤΕ/ΕΙΧΗΜΥΘ

ΗΜΕΡΟΜΗΝΙΑ & ΩΡΑ: Τρίτη, 1 Νοεμβρίου 2011, 16:00

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ΟΜΙΛΗΤΗΣ: **Professor Jean-Marie Basset**
Kaust Catalytic Center
King Abdullah University of Science and Technology (KAUST)
Thuwal, Saudi Arabia

ΘΕΜΑ: **Single Site Catalysis by design: The metathesis of alkanes and related reactions**

&

The King Abdullah University of Sciences and Technology: The Chemical Science Division and its Catalysis Center

ΤΟΠΟΣ: Αίθουσα σεμιναρίων ΙΤΕ/ΕΙΧΗΜΥΘ

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Metal-Organic Materials:
Strategies toward Functional Nanoporous Materials

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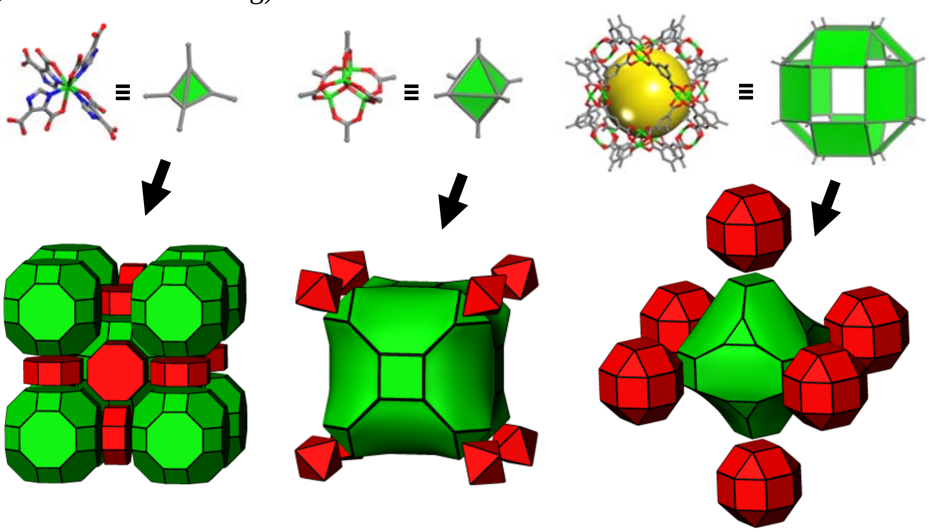
The quest for functional materials targeted for specific applications is ever increasing as societal needs and demands mount with advancing technology. One class of inorganic-organic hybrid materials, metal-organic materials (MOMs), has burgeoned in recent years due, in part, to effective design strategies (i.e. reticular chemistry) for their synthesis and their inherent [and readily interchangeable] hybrid, highly functional character. The molecular building block (MBB) approach introduces the ability to generate rigid and directional building blocks, mostly *in situ*, for the construction of MOMs having specific underlying networks and/or targeted functions/properties. Here we will discuss three basic strategies based on the MBB approach. Three classes of MBBs can be targeted and utilized in the assembly of functional MOMs: 1) single-metal-ion-based MBBs, which promote the rational construction, by forcing rigidity and directionality through control of the metal coordination sphere and judicious selection of suitable hetero-functional (N-, O- coordination) organic ligands, of porous MOMs with extra-large cavities, including zeolite-*like* metal-organic frameworks (ZMOFs); 2) multi-nuclear metal cluster-based MBBs, where, for example, simple metal-carboxylate clusters possess multiple metal-oxygen coordination bonds that result in the generation of rigid nodes with fixed geometry that, when combined with organic ligands of specific geometry, lead to the construction of desired MOMs (e.g. *soc*-MOFs); and 3) supermolecular building blocks (SBBs), which involve enhanced built-in directional and structural information (e.g. high degree of symmetry and connectivity) compared to simple MBBs and allow the construction of high-connectivity nets (e.g. *rht*-MOFs). The MBB approach and associated strategies, as well as physical properties of some corresponding MOMs (i.e. porosity, hydrogen sorption, catalysis, carbon capture, inclusion and sensing) will be discussed.



Dr. Mohamed Eddaoudi is a Professor of Chemical Science at KAUST, and Associate Director of the KAUST Advanced Membranes and Porous Materials Research Center.

Dr. Eddaoudi received his master's and doctorate in Chemistry from Denis Diderot University (Paris VII) in Paris, France.

Dr. Eddaoudi is a member of the American Chemical Society. He received the Outstanding Faculty Research Achievement Award (2004 and 2007) and the Chemistry Outstanding Teaching Award (2005 and 2008) from the University of South Florida. He was awarded the prestigious National Science Foundation Career Award in 2006. In 2006 he was selected as one of the 30 rising stars and young chemists in the U.S., whom were all then invited to present their research at the Second Transatlantic Frontiers of Chemistry Symposium.

Dr. Eddaoudi has given more than 60 invited talks at conferences and universities since 2002. His contribution to the field of metal-organic frameworks has been highly visible in peer-reviewed journals such as Science and Nature, and evidenced through his recognition by ISI as one of the top 100 most cited chemists of the past 10 years (ranked #68 in 2007 and #35 in 2010), http://in-cites.com/nobel/2007-che-top100.html.

Dr. Eddaoudi is regarded as one of the world leaders in the field of Metal-Organic Materials, a fast emerging field of solid state materials. He implemented the single-metal-ion-based molecular building block (MBB), the supermolecular building block (SBB) and the supermolecular building layer (SBL) approaches as means for the design and synthesis of functional metal-organic materials (MOMs). Dr. Eddaoudi has developed novel strategies, based on the molecular building block approach, for the construction of functional porous solids, namely Zeolite-*like* Metal-Organic Frameworks (ZMOFs) with tunable extra-large cavities and periodic array of organic and inorganic moieties. Dr. Eddaoudi has introduced ZMOFs as potential tunable platforms for applications pertaining to energy sustainability and environmental security: Hydrogen storage, Carbon dioxide capture, Toxic Industrials Chemicals filters, Sensing applications, Catalysts immobilization, and Controlled drug release.

“Single Site Catalysis by design: The metathesis of alkanes and related reactions”

and

“The King Abdullah University of Sciences and Technology: The Chemical Science Division and its Catalysis Center”

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Catalysis is the number one technology in chemical industry and petroleum refining: 95 percent of all products (volume) are synthesized by means of catalysis. The advantages of catalytic processes are due to the mild reaction conditions, their cost efficiency, and their environmentally friendly character. Nevertheless sometimes catalysis is not selective enough, which increases products involved in green house effects (like CO_2, NO_x or particles). New reactions are needed (for example, methane, which is abundant in the world, is not selectively transformed into valuable products). Catalysis using bio-based raw materials will gain more and more interest for the progressive replacement of fossil fuels.

A predictive approach of catalysis is emerging due to the spectacular progresses made in the synthesis of well defined materials. The nano-control of active site via a multidisciplinary approach is one of the ways to address this issue of catalytic “environmental” or “energy” performances. It is now possible to achieve the rational design and synthesis of well-defined materials with the expected structure, acidity, porosity in the field of oxides, carbon based materials or zerovalent mono and multi metallic particles of given size and composition. The grafting of organometallic compounds onto these materials results in the synthesis of “single site” catalysts both on oxide or metallic nanoparticles. The characterisation of the grafted organometallic complexes results from the use of a variety of techniques coming from surface science and molecular chemistry: *in situ* IR, *in situ* ^{1}H, ^{13}C NMR, 2D NMR, EXAFS, Surface Microanalysis, determination of the stoichiometry of surface reactions. The detailed knowledge of the structure of the active site which results from this careful determination allows one to determine elementary steps of heterogeneous catalysis and a structure activity relationship can be achieved in several cases. A new generation of catalysts, new catalytic reactions, improvement of existing catalysts, related to energy and environment have been discovered on these materials.

Examples will be given in the field of direct transformation of ethylene to propylene, Ziegler-Natta depolymerisation, supported metallocenes and polymerisation, Alkane metathesis, Methane coupling to ethane, Methane-olysis of alkanes, Metathesis of olefins, dehydrogenation of paraffins.

An overview of the KAUST University and its fascinating facilities for young scientists will also be given

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Dr. Jean Marie Basset has been appointed Director of the Catalysis Research Center, and Named Professor of Chemical Science at KAUST. He assumed his duties in September 2009.

According to Dr. Basset, catalysis is a strategic domain for Saudi Arabia. It is a critical enabling science for the Kingdom"s energy future. Improvement in the catalytic processes across the chemical and petroleum industries will increase resources and energy utilization efficiencies and reduce waste. In the future, cost-effective, environmentally sound utilization of energy resources will require new catalysts and processes. Efficient photo catalysts for water splitting are needed if these technologies are to become practical on a large scale. To meet these challenges the field must advance from catalyst discovery to catalysis by design.

Dr. Basset served as scientific director of the school of Chemistry, Physics and Electronics at the University of Lyon in France. He was appointed research Director at the Centre National de la Recherche Scientifique (CNRS) in 1987, and funded his laboratory of Surface Organometallic Chemistry that he has held since 1994. Dr. Basset"s Lyon lab is home to 50 scientists, including Nobel Laureate Yves Chauvin. He came to CNRS in 1971 and has occupied several positions, including vice director of the Institute of Catalysis (Lyon). Dr. Basset also founded the consortium, "Actane," on alkane activation with 11 university labs and five companies. Since 1992, he also has served as scientific director of L"École Supérieure de Chimie Physique Electronique de Lyon (CPE, Lyon), which has trained 450 chemists in a three-year scholarship program.

Dr. Basset founded and serves as president of Integrated Design of Catalytic Nanomaterials for a Sustainable Production (IDECAT). IDECAT is the only European Network of Excellence in Catalysis, which includes 40 labs and 20 companies.

A Distinguished author of over 450 journal and conference papers, Dr. Basset"s research interests include the relationship between homogeneous and heterogeneous catalysis. His research also includes, the synthesis of single site catalysts in various fields of chemistry, petroleum, and polymers.

Dr. Basset holds various professional memberships, is the recipient of several international and national awards, and is Doctor Honoris Causa of several universities. He received his doctoral and master's degrees at the University of Lyon