Catalysis Club of Philadelphia

Thursday, April 20th, 2017
DoubleTree Hotel
4727 Concord Pike Wilmington, DE 19803

Professor Avelino Corma
Solid Catalysts Design: From Fundamental Knowledge To Catalytic Application

Professor and founder of the Instituto de Tecnología Química (UPV-CSIC) in Valencia, Spain

Social Hour: **5:30 PM**
Dinner: **6:30 PM**
Meeting: **7:30 PM**

Members: $35.00
Walk Ins & Non-members: $40.00
Students & Retired Members: $20.00

Menu*

Stuffed Chicken – with spinach, sun-dried tomato, shredded mozzarella, and garlic white wine sauce
Portabella Stuffed Ravioli (veg) – with a white wine sage butter sauce
Sliced Sirloin Steak– with wild mushroom demi glaze

**Served with a salad, rolls and butter, chef's choice of desserts, coffee, tea, iced tea, decaf and water.*

Meal reservations – Please register online by ***Friday, April 14th*** at http://catalysisclubphilly.org/program/ meeting-registration/ or notify your company representative or our Arrangements Chair Tzia Ming (tonn@seas.upenn.edu)

Membership - Dues for the 2016-17 season will be $25.00 ($5.00 for the local chapter and $20.00 for the national club). Dues for students, post-docs and retirees will be $10.00 ($5.00 for local club and $5.00 for national club).

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Abstract: The key point in catalysis is to define and synthesize the specific active site that will minimize the activation energy of the reaction, while forming selectively the desired product. In the case of homogeneous catalysis, highly selective molecular catalysts can be designed and /or optimized from the fundamental knowledge accumulated on chemical reactivity, and the possibilities offered by molecular modelling, in situ or operando spectroscopy, kinetics and advanced catalyst synthesis. Then, when the catalytically active centers are defined, and their interaction with reactants and products can be rationalized, it could, in principle, be possible to predict and prepare more active and selective catalysts.

In the case of solid catalysts it becomes more difficult to define and specifically build the active sites due to surface heterogeneities present in most of the solids. Indeed, one should consider that the presence of non-controllable surface defects and the fact that surface reconstruction may occur during the catalytic reaction, makes the identification and synthesis of the active sites in solid catalysts a big challenge.

From the point of view of maximizing active sites, and since catalysis with solids is a surface phenomenon, high surface solid catalysts are most of the times preferred. In this case it is not a simple task to identify the assembly of atoms, and therefore to establish the enthalpy and entropy effects at the interface of the solid-gas or solid-liquid, that will be responsible for the catalytic effect at the molecular level. Moreover, even when the above is achieved, to synthesize the solids with well defined, homogeneous single or multiple catalytically active sites it is a difficult task. Notice that reaction selectivity will depend on the capacity to prepare the solid avoiding the presence of sites other than the desired ones.

It was our objective, since the first moment, to design and synthesize solid catalysts in where we could build within the structure (almost like in a lego), on the bases of the knowledge developed on reaction mechanisms, adsorption interactions and materials synthesis procedures, the potential catalytic active sites. We expected that, if successful, this

could be one way to achieve solid catalysts with well defined, uniform single or multiple active sites. It also appeared to us that working in that way it should be possible to build bridges between the homogeneous and heterogeneous catalysis. We are aware that in the case of the solid catalysts would not be possible to achieve the fine tuning of electronic, geometric and chiral effects obtained by means of the ligands and molecular structure, with transition metal complexes, and organic molecules in homogeneous catalysis. Nevertheless, we attempted to use the surface topology, textural characteristics and chemical composition of the solid to master molecular diffusion and adsorption of reactants, while selecting one among the different possible transition states.

We will present what has been our evolution on the design of three types of solid catalysts in where we followed the methodology describe above. They are:

a) High surface area hybrid organic-inorganic catalysts in where we attempt to regulate the characteristics of the active sites and the geometrical flexibility to maximize dispersion forces.

b) Fully inorganic highly thermically stable micro and mesoporous materials with well defined single sites, while controlling molecular diffusion and adsorption to achieve remarkable selectivity effects.

c) Generating and stabilizing from single metal atoms to clusters with a few atoms to nanoparticles, with reactivities so high that remind those of enzimes.

We will show that by following the methodology: “understanding for designing and synthesizing”, we could also achieve what it is always a desirable objective in catalysis: “Designing for industrial application”.

Biography: Avelino Corma, Professor and founder of the Instituto de Tecnología Química (CSIC-UPV) in Valencia (Spain), he has been carrying out research in heterogeneous catalysis in academia and in collaboration with companies for nearly 35 years. He has worked on fundamental aspects of acid-base and redox catalysis with the aim of understanding the nature of the active sites, and reaction mechanisms. With these bases has developed catalysts that are being used commercially in several industrial processes. He is an internationally recognized expert in solid acid and bifunctional catalysts for oil refining, petrochemistry and chemical process, especially in the synthesis and application of zeolite catalysts. He has published more than 900 research papers, and inventor on more than 130 patents. Corma earned his BS in Chemistry at Valencia University, PhD at Madrid under direction of Prof. Antonio Cortes, and spent two years postdoc at Queen´s University. He has received the Dupont Award on “Materials Science”, Ciapetta and Houdry Awards of the North American Catalysis Society, the F. Gault Award of the European Catalysis Society, the M. Boudart Award on Catalysis by the North American and European Catalysis Societies, the G. J. Somorjai ACS Award on Creative Catalysis, the Breck Award of the International Zeolite Association, the National Award of Science and technology of Spain, "Rey Jaume I" Prize for New Technologies (2000), the ENI Award on Hydrocarbon Chemistry, the Royal Society of Chemistry Centenary Prize, Solvay Pierre-Gilles de Gennes Prize for Science and Industry and Gold Medal for the Chemistry Research Career 2001-2010 in Spain, La Grande Médaille de l'Académie des sciences de France 2011 and Honour Medal to the Invention from the Fundación García Cabrerizo in Spain. Gold Medal Foro QUÍMICA y SOCIEDAD to all his research career, Gran Medaille of the Science French Academy, Edith Flanigen Lectureship, Eastman Lecture, Director´s Distinguished Lecture Series Pacific Northwest National Laboratory´s. Prince of Asturias Award for Science & Technology 2014, 48th W. N. Lacey Lectureship in Chemical Engineering-Caltech (2015) and

The Jacobus van 't Hoff Lecture 2015 at TU Delft Process Technology Institute (2015), The Hoyt C. Hottel Lecturer in Chemical Engineering at MIT Chemical Engineering Department (2015), J.T. Donald Lecture series 2015-2016 at McGill University, Spiers Memorial Award RSC (2016), IZA Award of the International Zeolite Association (2016), George C.A. Schuit Award lecture at the University of Delaware (2016).

"Doctor Honoris Causa" by Utrecht University (2006), UNED (2008), München Technological University (2008), Universidad Jaime I de Castellón (2008), Universidad de Valencia (2009), Bochüm University (2010), Universidad de Alicante (2010), Ottawa University (2012) Delft Technological University (2013) Jilin University (China) (2013), University of Bucarest (2014), Jaen (2016), Cantabria (2016).