

## Interfacial Thermodynamics and the Design of Ordered Metal Oxide Nanoarrays

Speaker: **Dr Lionel Vayssieres**, National Institute for Materials Science, International Center for Young Scientists, Japan  
Venue: Blk EA, #06-02, Faculty of Engineering, NUS  
Date: 19th June 2006 (Monday)  
Time: 2.30pm – 3.30pm

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### Abstract:

The ability to design one-dimensional building blocks with tailored aspect ratio and to order them into large 3-D arrays is an important challenge scientists have to face to create smart and functionalized nanodevices. Our approach to control the size and shape of nanoparticles as well as the overall texture of particulate thin films is to tune their direct aqueous hydrolysis-condensation growth onto substrates by monitoring the interfacial thermodynamics of nanocrystals as well as their kinetics of heteronucleation. This is achieved by minimizing the surface energy at the water/oxide interface according to a general quantitative model based on Gibbs adsorption equation. Indeed, growing materials at very low interfacial tension, i.e. at thermodynamically stable conditions, allows the experimental control of the extension and rate of the nucleation and growth stages. Thus, different sizes, shapes, and orientations can be generated onto various substrates. Consequently, the design and fabrication of novel devices with tailored and engineered three-dimensional architecture can be obtained from aqueous solution without template, surfactant, applied field, or undercoating. Such ideas will be demonstrated on transition metal oxides materials at nano-, meso-, and micro-scale, and illustrated on their growth as 3-D arrays with controlled orientations onto various substrates as well as the characterization of their electronic structure, photoelectrochemical, and magnetic properties.

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### Biography:

Born in 1968, Dr Lionel Vayssieres obtained a MSc. in Physical Chemistry in 1991 and a Ph.D. in Inorganic Chemistry in November 1995 from the Université Pierre et Marie Curie in Paris, France for his research work on the *Interfacial and thermodynamic growth control of metal oxide nanoparticles in aqueous solutions*. Thereafter, he joined Uppsala University, Sweden as a postdoctoral researcher for the Swedish Materials Consortium on Clusters and Ultrafine Particles to extend his concepts and develop *purpose-built metal oxide nanomaterials* for photoelectrochemical applications as well as to characterize their electronic structure by x-ray spectroscopies at synchrotron radiation facilities. He has been invited as a visiting scientist: at the department of Chemical Engineering at the University of Texas at Austin, USA on nanocomposite metallic oxides for biosensors, at the UNESCO Centre for Macromolecules & Materials and at the department of Biochemistry, at Stellenbosch University, South Africa on bio-nanocomposite materials, at the Glenn T. Seaborg Center, Chemical Sciences Division, at Lawrence Berkeley National Laboratory, USA on actinide nanomaterials, at the Texas Materials Institute on metal oxide-based nanomaterials for optical, magnetic, and energy storage and conversion devices, and at the Ecole Polytechnique Fédérale de Lausanne (EPFL), Switzerland on metal oxide oriented arrays for photocatalytic devices.

He has (co-)authored 50 refereed publications, 3 ISI highly cited papers for the last 10 years, #1 in the Top 10 hot papers published in the last 2 years in Chemistry (Jul-Aug 05), #2 in the Top 3 hot papers published in the last 2 years in Materials Science (Sep-Dec 05) and #3 (May-June 05) in major international journals, refereed proceedings and book series, which have generated about 1000 citations (1 paper over 200 citations, 2 over 100, 3 over 50). He has presented over 100 lectures at universities, research institutes and international conferences as well as acting as session chairman, program committee and advisory member at major conferences and projects worldwide.

He is currently a senior research scientist at the International Center for Young Scientists, National Institute for Materials Science (NIMS) in Tsukuba, Japan; a R&D consultant for Hydrogen Solar Ltd., UK; a guest scientist at the Chemical Sciences Division and the Advanced Light Source at Lawrence Berkeley National Laboratory, USA as well as at the Materials Chemistry Department at Ångström Laboratory, Uppsala University, Sweden. He is the conference chairman of the first symposium dedicated to **Solar Hydrogen & Nanotechnology** organized by the *International Society for Optical Engineering* to be held at the convention center in San Diego, CA USA August 13-17, 2006 during the SPIE 2006 Optics & Photonics meeting. He is also the founder and editor-in-chief of a new journal dedicated to reviews in nanotechnology and related fields, the *International Journal of Nanotechnology* published by Inderscience Entreprises Ltd.