

Title PVD of advanced nano-catalysts for Sustainable Energetics

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Abstract

Bridging the gap between fundamental knowledge of physical and chemical properties of nanostructured catalysts and applied catalysis allows designing of new groundbreaking catalytic systems. Deep exploring of physical properties of catalyst nanostructures is helping chemists to develop or improve new catalysts through an interactive interdisciplinary loop involving fundamental solid state physics, advanced material synthesis, surface science, in-situ operando spectroscopy, theory and characterisation.

A rapid transition from fossil fuels to renewable energy sources is becoming every day more and more necessary. Water electrolyzers (WE) and hydrogen fuel cells (FC) represent a promising and flexible technology for converting wind and solar electrical energy to hydrogen, and hydrogen stored energy into electricity with a high environmental sustainability.

Platinum and iridium are the most versatile elements in hydrogen energy storage catalysis, but they are rare and their high price limits large-scale applications of fuel cell and electrolysis technology. Still, conventional catalysts use only a small fraction of the Pt content, i.e. those atoms located at the catalyst's surface. To maximize the noble metal efficiency, metals should be atomically dispersed and located at the very surface layer of the material.

Preparation of catalysts using thin film (TF) techniques is not used yet in heterogeneous catalysis because TF technologies are generally considered as incompatible with the preparation of sufficiently large surface areas. However, high-surface-area nanoporous catalyst films containing very low amount of precious metal can indeed be prepared by suitable deposition techniques.

The new class low cost electro-catalysts were prepared by magnetron sputtering deposition of ultrathin Pt and Ir films on ion conductive polymer composites containing conductive ceramic nanoparticles. The WE and FC tests revealed their high stability and activity. Advanced synchrotron radiation and near ambient pressure XPS, electron and scanning probe microscopies were used for materials and surface characterisation.

About the Speaker

Prof. Vladimír Matolín has performed scientific activities focused mainly on surface science and investigation of platinum and ceria based model and real catalysts for low temperature CO oxidation and hydrogen oxidation reaction in proton exchange membrane fuel cells during last 5 years. He proposed novel method for preparation of low platinum content PEMFC catalysts based on thin film technology. Plasma assisted reactive magnetron sputtering has been used for preparation of multilayer nano-porous PEMFC electrodes; in case of the anode with Pt content of 2 - 4 $\mu\text{g Pt}/\text{cm}^2$. He is author and co-author totally 330 scientific papers, H index = 32 (source Web of Science) published in international refereed journals, one book chapter and 8 granted patents. Some papers were published in high-impact journals JACS, Angew. Chem Int. Ed., Nature Materials, Nature Communication, Phys. Rev. Lett., Phys. Chem. Lett. etc.

Host: Prof. Stephen Lyth

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