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ENERGYPOLIS SEMINAR

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Nanomaterials by gas-phase condensation: applications to hydrogen storage and photocatalysis

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The gas-phase condensation (GPC) technique is a bottom-up approach to the growth of nanostructured materials for a wide range of applications, originally pioneered by Gleiter for the preparation of bulk 3-dimensional nanomaterials [1]. GPC employs one or more vapor sources (based on either thermal evaporation, sputtering, laser ablation, spark discharge generation) under inert gas at sufficiently high pressure to induce supersaturation and subsequent nucleation of nanoparticles directly from the vapor.
I will give two examples of nanomaterials prepared by GPC, with potential applications in energy-related fields. The first example focuses on hydrogen sorption (kinetics and thermodynamics) of Mg-based nanoparticles, which are decorated or finely intermixed with transition metals by means of sequential deposition or co-evaporation [2,3]. We have recently shown that GPC allows growing alloy nanoparticles from immiscible elements like Mg and Ti [4], achieving very fast hydrogen desorption kinetics. The second example deals with 2nd generation photocatalysts, i.e. doped TiO_2 with enhanced visible light activity. GPC was employed to deposit V-doped TiO_2 nanoparticle-assembled coatings with high porosity by evaporation of a Ti-V alloy in a He/O_2 mixture. I will present a study on the local structure of V dopant in rutile and anatase TiO_2, carried out by X-ray Absorption Spectroscopy in the hard and soft X-rays regime [5].

References:

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[2] E. Callini, L. Pasquini, E. Piscopiello, A. Montone, M. Vittori Antisari, E. Bonetti. *Hydrogen sorption in Pd-decorated Mg–MgO core-shell nanoparticles*. Appl. Phys. Lett. **94**, 221905 (2009)
[3] L. Pasquini, F. Boscherini, E. Callini, C. Maurizio, L. Pasquali, M. Montecchi, E. Bonetti. *Local structure at interfaces between hydride-forming metals: A case study of Mg-Pd nanoparticles by x-ray spectroscopy*, Phys. Rev. B **83**, 184111 (2011)
[4] M. Calizzi, F. Venturi, M. Ponthieu, F. Cuevas, V. Morandi, T. Perkisas, S. Bals and L. Pasquini, Phys. Chem. Chem. Phys. *Accepted Manuscript*, **DOI:** 10.1039/C5CP03092G
[5] G. Rossi, M. Calizzi, L. Amidani, L. Pasquini, F. Boscherini, *in preparation*

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