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Novel approaches of doped metal oxides nanostructuring and surface engineering towards more sustainable and autonomous plasmonic electrochromic systems

Anthony Maho (ICMCB - University of Bordeaux)

Plasmonic nanostructures of doped metal oxides such as indium-tin oxide ITO are well-known for their selective and controlled modulation ability of NIR radiations in advanced electrochromic systems, as a consequence of the capacitive tuning of their carrier concentration through external electrical bias. Such materials are integrable in dynamic heat-filtering smart windows devices, additionally showing extremely fast switching kinetics as well as high optical contrasts, coloration efficiency, and cycling durability.

The present contribution will highlight different colloidal synthesis methodologies of ITO nanocrystals based on Schlenk line thermal decomposition and on hydro/solvothermal protocols, leading to stable and easily-workable dispersions in highly polar and low-toxic media. Such dispersions can then be used as “precursor inks” in wet deposition processes, especially spray coating, leading to uniform and highly-covering electrochromic thin films onto glass substrates. Ultimately, optical and electrochemical properties of the generated NIR-modulating layers are shown to be strongly dependent on the synthetic and post-synthetic treatments and conditions.

The talk will also address the challenge of directly interfacing ITO nanostructured films with pentacene molecular layers, well known as light absorbing, electron donor materials in many optoelectronic and photovoltaic applications in view notably of their spin-allowed singlet fission properties. Practically, ITO and pentacene can be processed into bilayers from consecutive spin coating and organic molecular beam deposition, respectively, allowing for *in-situ* electron generation in pentacene as organic photodonor and transfer towards ITO as inorganic photoacceptor. Materials microstructural and optoelectronic properties are carefully assessed through SEM, AFM, XRD, Raman, VIS-NIR spectrometry and transient absorption spectroscopy TAS, with obtained results highlighting their high-

impact potential as self-powered NIR electrochromic filters, all in all targeting more and more materials sustainability and device autonomy.

This work involves research contributions recently achieved and/or under progress by University of Liège – GREEnMat in Belgium (Prof. Rudi Cloots), University of Texas in Austin (Prof. Delia J. Milliron), Imperial College London (Prof. Sandrine Heutz) and University of Bordeaux / ICMCB-CNRS (Dr. Aline Rougier).