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Nanoscience and nanotechnology of transparent electrodes

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The past few years have seen a considerable amount of research devoted to nanostructured transparent conducting materials (TCMs). Thanks to their excellent electrical and optical properties, nanostructured TCMs play a pivotal role in many modern devices such as: solar cells, flexible light-emitting devices, touch screens and flexible transparent heaters. The huge demand in industry for transparent electrodes (with the expansion of screens, OLEDs and photovoltaic) leads to the replacement of indium tin oxide (ITO) which is fragile and likely to become expensive due the scarcity of Indium. This contribution aims at presenting an overview of the main physical properties and applications of TCMs and the challenges which still remain in front of us. This discussion will be mainly illustrated through two TCMs: Fluorine doped tin oxide (FTO) and silver nanowire networks which have both received increasing interest due to their promising applications. The interplay between structural and physical properties of thin polycrystalline FTO films is discussed as well as the predominant electron scattering mechanisms which control the carrier mobility. Experimental and simulation approaches aim to understand and improve the physical properties of Silver nanowire networks. Indeed, we show that a thermal annealing can drastically improve transport properties and we also explore the optimization of the network density, by using both experimental and simulation approaches. The resulting percolating networks exhibit excellent properties. This contribution will emphasize the importance of nanoscience and nanotechnology phenomena for materials that should be integrated in everyday life devices.

Biography

Daniel Bellet has completed his PhD at 26 years old from Grenoble University (France). He was a junior member of the "Institut Universitaire de France" (IUF), an institution which promotes high level research within French universities, between 1999 and 2003. He spent one sabbatical year in the Center of Excellence of Photovoltaic in Sydney (Australia) in 2006-2007. He is now Full professor at Grenoble Institute of Technology and his research activities focuses on the physics of materials, mainly for energy applications. He heads the Academic Research Community of Energies at the Region Rhone-Alpes.

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