EuroSciCon

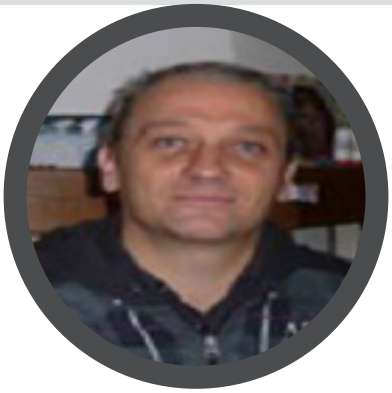
EuroSciCon Conference on

Nanotechnology & Smart Materials

October 04-06, 2018
Amsterdam, Netherlands

D Bellet et al., Nano Res Appl Volume:4
DOI: 10.21767/2471-9838-C6-023

NANOMATERIALS FOR TRANSPARENT ELECTRODES: PROPERTIES, CHALLENGES AND PROSPECTS



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The past few years have seen a considerable amount of research devoted to nanostructured transparent conductive materials which play a pivotal role in many modern devices such as: solar cells, flexible light-emitting devices, touch screens, electromagnetic devices or flexible transparent thin film heaters. Currently, the most commonly used material for such applications (ITO: Tin-doped Indium oxide) suffers from two major drawbacks: indium scarcity and brittleness. Among emerging transparent electrodes, silver nanowire (AgNW) networks appear as a promising substitute to ITO, since these percolating networks exhibit excellent properties with sheet resistance of a few Ω/sq and optical transparency of 90%, fulfilling the requirements for many applications. It also shows very good electro-mechanical properties. Their main properties, the influence of post treatments or the network density and nanowire size but as well their stability will be discussed, thanks to both experimental and numerical approaches. Some applications will be developed such as their use as transparent heaters or in solar cells. As well, other indium-free transparent conductive oxide (TCO) layers have being investigated and some exhibit interesting properties. We will present the main scientific challenges associated to their physical properties. For instance the electron mobility in highly doped Al-ZnO or F-SnO_2 will be discussed as well the capability to control the haziness of such transparent electrodes. We will show as well that recently some developments of easily up-scalable and vacuum-free deposition techniques such as atmospheric pressure spatial atomic layer deposition (AP-SALD) appear promising for developing high-quality materials with a high throughput at low temperature (≤200°C), thus being compatible with polymeric substrates and roll-to-roll processing. This contribution aims at presenting briefly the main properties of transparent electrodes as well as the challenges which still remain in terms of efficient integration in devices.

Biography

Daniel Bellet has became an Assistant Professor at Grenoble University in 1990 and is Professor at Grenoble Institute of Technology (Grenoble INP) since 1998. He was Junior Member at IUF (Institution for promoting excellence in French Universities) from 1999 to 2004, and was Director of the academic research community 'Energies' at the Région Auvergne-Rhone-Alpes between 2011 and 2017. His research is focused on material physics and more specifically now on transparent conductive materials and he is a Co-Author of more than 140 peer-reviewed publications or proceedings, 8 book chapters and has an h-index of 33.

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