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Transparent and conductive nanomaterials

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 as well as in several energy technologies. The latter concern for instance solar cells and light-emitting devices. Currently ITO (tin-doped indium oxide), the most commonly used material for such applications, suffers from two major drawbacks: Indium scarcity and brittleness. This contribution aims at briefly reviewing the main properties of transparent electrodes as well as the challenges which we still face in terms of efficient integration in devices for several energy technologies. A more specific focus will be devoted to two promising TCMs. First the emerging transparent electrodes based on silver nanowire (AgNW) networks, which appear as a promising substitute to ITO with excellent optical and electrical properties fulfilling the requirements for many applications including flexible devices. In addition, the fabrication of these electrodes involves low-temperature processing steps and up-scaling methods, thus making them very appropriate for future use as TE for flexible devices. 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. We will also show that low cost and atmospheric pressure spatial atomic layer deposition (AP-SALD) technique drastically enhances the stability of AgNW networks thanks to a very conformal coating. The second studied TCM is based on Fluor-doped Tin Oxide (FTO) which exhibits interesting optoelectronic properties. We have shown recently that an even more promising and innovative TCM can be fabricated from S:TiO2-FTO nanocomposites which shows tuneable high haze factors from almost zero to 60% by using a simple and cost effective method. The resulting optoelectronic properties of such TCM appear very well suited for its efficient integration into solar cells.

Biography

Daniel Bellet became an Assistant-Professor at Grenoble University in 1990 and is Professor at Grenoble INP since 1998. He was junior member at IUF (French Institution to promote excellence in research) from 1999 to 2004, and is now the Director of the Academic Research Community Energies at the Région Rhône-Alpes since 2011. His research is focused on Material Physics and more specifically now on Transparent Conductive Nanomaterials. He is a Co-author of more than 120 peer-reviewed publications or proceedings and eight book chapters.

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