Graphene for Advanced Solar Cells

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Graphene, a two-dimensional version of carbon, has been attracting increasing interest both from companies and research groups since the publication of the pioneering work by Novoselov *et al.* in 2004 [1]. The expectations generated by this exciting material are being enormous, and there is no doubt that graphene has outstanding properties which in principle would fit in well with the area of energy-generation devices owing to its specific characteristics.

In the next few years, photovoltaic (PV) technology is expected to play a major role in the renewable-energy sector because of the fight against the climate change. Nowadays, the PV market is dominated by silicon-wafer technology. Its roadmap shows that there is a strong trend towards making thinner and cheaper cells. In this sense, silicon-heterojunction cell (SHJ) technology emerges as a potential low-temperature solution because it involves excellent performances and low energy consumption for fabrication [2].

The progress in silicon-heterojunction cells requires to develop new architectures of transparent front electrodes in order to generate and extract current in a more efficient way. State-of-the-art contacts for this application are a wide variety of transparent conductive oxides (TCOs). Among them, the one most commonly used is an 80-nm-thick indium tin oxide (ITO) layer. But the cost and scarcity of indium and its rather limited sheet resistance, not below 100 Ω/sqr for such thicknesses, lead to the search of new strategies [3].

In the present work, new architectures of indium-free TCO-based transparent electrodes incorporating one, two and three atomic graphene layers, respectively in different configurations (see Fig. 1 (a) and (b)) are explored as possible approaches to improve silicon-heterojunction-cell front contacts. The results reveal that the transparent-electrode properties dramatically depend on the order in which the layers have been deposited. The comparison of spectral reflectances of TCO-on-crystalline-silicon without and with graphene transferred on top, show a reduction which is considered essential to validate this approach.

References

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Figures

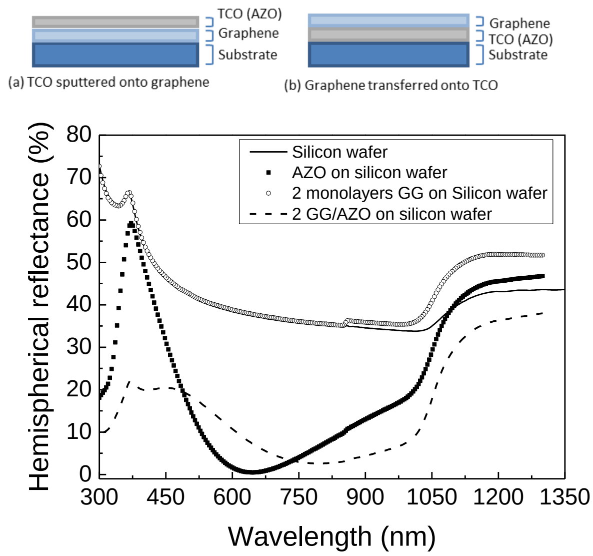

Figure 1: Hemispherical reflectance spectra of samples in study.

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