Influence of carbon-based materials as a counter electrode in dye-sensitized solar cells.

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The first dye-sensitized solar cells (DSSC) in 1991 were detailed by Michael Grätzel [1]. Since then, studies have been done based on improving their photovoltaic performance and achieving high energy conversion efficiencies.
DSSCs are based on a working electrode covered by a thin layer of a semiconductor, usually, TiO_2 (with a photosensitizer dye), which acts as an anode and is separated from a cathode, which is usually mainly platinum, by means of an electrolyte solution, which contains a redox couple (often I^-/I^{3-}) [2].
Recently, there has been an increase in the use of other metals and carbon-based materials to replace Pt as counter electrodes (CE) in this solar technology and lower the price of the device. The carbon-based materials result in a low cost alternative to replace the metals mainly used for this type of solar cells. However, they present some drawbacks as the low surface adhesion with the TCO substrate.
In this work, a comparative study of solar cells has been carried out using Pd as counter electrodes (as a reference) and a carbon-based material as an alternative to Pd. 70 nm-thick carbon-related layer was deposited with a confocal magnetron sputtering operated in direct current (DC) on the transparent conductive oxide film used (ITO). This deposition was carried out at room temperature (RT), 400W of DC power and an Argon working pressure of 1.4 Pa. One of the main aims of using such deposition technique was to improve the film adherence to the TCO.
The materials obtained were characterized electrically, optically, structurally, etc. with various characterization techniques. From ellipsometric measurement at 65°, 70° and 75° incidence angles (Fig. 1a and 1b) the optical constants of the carbon-based material have been calculated using a modified Forouhi-Bloomer plus Tauc-Lorentz model (Fig. 1c).

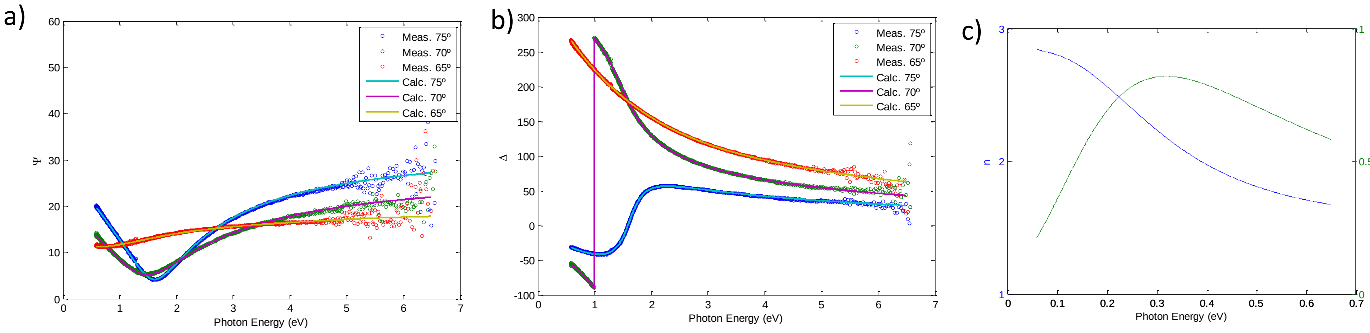

Figure 1: a) 75°, 70° and 60° Ψ and b) Δ ellipsometric measurements (circles) and model fit (solid lines). c) Refractive Index and Extinction Coefficient of the fitted sample.

References

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