Semitransparent Top-electrodes based on Carbon Nanotubes for Perovskite Solar Cell Technology

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Aesthetic semitransparent perovskite solar cells (PSCs) have been receiving growing attention because of their specific application in transparent architectures, for example windows, rooftops and greenhouses [1]. Several studies have reported semitransparent PSCs based on evaporated thin metal films (Al, Ag, Au) as top electrodes [2, 3]. We investigate a lamination process that involves Carbon NanoTubes (CNTs). CNTs, with its excellent electrical conductivity, chemical stability and unique nanostructure, have been applied as electrodes in CdTe, dye sensitized solar cells and organic solar cells [4]. In literature CNTs have been introduced in various components of PSCs, such as perovskite layer, hole transporting layer and semi-transparent top electrode [5]. In the latter case the CNTs are usually prepared by transferring/lamination procedure [4] or by spraying technique [6].

In this work we have used free standing Single Wall CNTs (SWCNTs) and Multi Wall CNTs (MWCNTs) (Figure 1) obtained by a vacuum filtration method [4]. The obtained foils have been laminated on to the glass by a direct transfer of the CNTs film on to the glass. The used procedure can be successful applied to flexible substrates.

We evaluate the results by microscope images (Figure 2), 4-wires probes measures and UV-vis spectra. Finally, we calculate the Average Visible light Transmission (AVT). The MWCNT shows less nanotubes per cm^2 respect to the SWCNT (Fig. 16). Moreover in the first case sheet resistance and AVT are one order of magnitude and 20% more than the second case, respectively. The efficiency of a small area PSC with SWCNTs semitransparent top-electrode is around 8%. Finally, CNTs could be considered as a potential candidate to realize semitransparent top-electrodes for Perovskite-based solar cells.

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References

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Figures

Figure 1: Free standing CNTs

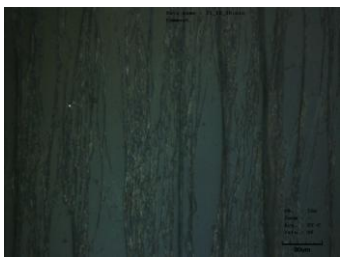

Figure 2: Image of the laminated CNTs