MceMge32-010

Dye interaction study and the addition of rGO on ZnO based DSSC

Silva, P.M.(1); Serna, M.M.(2); Galego, E.(2); Faria, R.N.(2);
(1) IPEN; (2) IPEN-CNEN;

Dye sensitized solar cell (DSSC) is an excellent device for architectural applications due to its variety of colors. The solar conversion efficiency into electrical energy of this devices depends on the dye used, which is related to the wavelength range that is absorbed by the dye and the type of the interaction between the dye molecule and the semiconductor film. The type of interaction between the dye molecule and the semiconductor can impact the conversion rate of photogenerated electrons due to the recombination process that might occur inside the DSSC cell. Due to its extremelly high conductivity, the graphene is an eligible additive for the photoanode in order to avoid recombination process within the semiconductor film. In the present work, the conversion efficiency of the N719, D149 and Eosin Y dyes adsorbed on ZnO and the addition of reduced graphene oxide (rGO) on ZnO photoanodes have been studied. The photoanodes were prepared using a nanocrystalline ZnO/rGO paste. The 1% (wt) concentration of rGO was used in this work. The paste was coated on FTO using Doctor Blade method and annealed at 450 °C and 550 °C employing a heating rate of 5ºC/min and a dwell time of 1 h for further reduction of the rGO. This was carried out for the additional remotion of organic radicals and the consequently improvement of the conductivity. The as-prepared photoanodes were immersed on 0,5 mM solutions of the dyes N719 and D149 and a 1 µM of the dye Eosin Y for 18h. Immediately after the dye sensitization, the DSSCs were assembled using FTO/Pt counter-electrodes and iodide/triiodide redox pair electrolytes. This additional reduction of the rGO was evaluated using Raman spectroscopy. The morphology and homogeneity of the semiconductor film have also been investigated using scanning electron microscopy (SEM). The electrical parameters of the devices were measured using a solar simulator under 100 mW/cm2 illumination and air mass 1.5. SEM images revealed the porous structure and homogeneous thickness of the film, as well as the pores and cracks on its surface, which allows the dye to percolate throughout the film. The Raman spectra exhibited the G band more intense than the D band, which indicates the efficient removal of organic radicals from rGO. The N719 is a standard dye due to its wide absorption of the visible light, hence it presents a deep red, almost black color, which results the best efficiency regardless the rGO addition. The D149 and Eosin Y are metal-free dyes and present light brown and bright orange colors (the D149 ranging from light brown to black and the Eosin Y from yellow to bright orange). The use of D149 e Eosin Y dyes prevents the formation of Zn2+/dye complexes and the efficiency conversion of the devices assembled using these dyes are similar.