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ZnO-DSSC: addition of graphene to obtain a new energy level between ZnO/FTO-glass.

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Resumo:
In the search for clean energy generation, solar energy has so far occupied the leading role; among the various factors that favor it are the possibility of generating energy on the surface of the planet and in outer space, in addition to the small environmental impact of generation plants and the possibilities of generation in urban environments. Within the different types of solar cells, dye-sensitized solar cells (DSSC) promise to revolutionize energy generation through their application as the external coating of large buildings. In the manufacture of this type of cell, non-toxic and low-cost materials are used; however the maximum conversion efficiency is still low when compared to silicon cells. One of the factors that contribute to the decrease in efficiency is the process of recombination of the photogenerated electron with the electrolyte. In the most common type of DSSC that uses a glass substrate coated with SnO2:F (FTO) to manufacture the photoanode, this surface acts as a recombination site. The objective of this work was to study the addition of a graphene layer between the FTO and the semiconductor oxide film in order to minimize recombination processes through the insertion of a new energy level. The deposition of reduced graphene oxide (rGO) was carried out by dip coating with different numbers of deposition cycles (0, 2, 5, 10 cycles). A ZnO paste was deposited on this film using the doctor blade technique with a green thickness of 50 µm. The assembly was heat treated at 450 °C for 1 h, aiming to reduce rGO to graphene and aggregate ZnO into a porous structure. The set was sensitized with the dye N719 and the solar cells were assembled

with an FTO/Pt counter electrode and an electrolyte with the iodide/triodide redox couple. The electrical parameters were obtained from the survey of IV curves in a solar simulator with a power of 100 mW cm-2 and air mass 1.5. The morphology of the photoanode was studied by scanning electron microscopy (SEM). The micrographs obtained by SEM show that a porous ZnO film was formed with an average thickness of 25 µm. The cell efficiency increased with the increase in the number of dip coating cycles from 0.39% without rGO to 0.72% with 10 cycles of rGO deposition. The variation in the fill factor was less than 10%. The series resistance values are of the same order of magnitude, indicating that the rGO did not act to increase the conductivity at the rGO/FTO interface, whereas the series resistance values will increase with the increase in the number of cycles, which allows us to conclude that the rGO acts as a blocking layer preventing the regeneration of the electrolyte with the photogenerated electron.