Structural and electrical properties of sodium titanate nanotubes decorated with $CuInS_2$ and NSGQD nanoparticles as promising materials for solar cells

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Titanium dioxide (TiO_2) is one of the most widely used high bandgap semiconductors in solar energy and photocatalysis applications due to its low cost and wide availability. Its particular electronic structure helps prevent electron-hole recombination [1,2]. TiO_2 has been studied in its different polymorphs and nanostructures, standing out the one-dimensional nanostructures since they promote directional conduction and decrease inter-particle contacts, thus favoring electronic transport [3]. It is possible to use nanoparticles of other smaller gap semiconductors as sensitizers, such as $CuInS_2$(CIS) [4] or graphene quantum dots (GQD), which can be activated in the visible spectrum in order to harvest light.

In this work, composites of sodium titanate nanotubes with two populations of CIS nanoparticles synthesized by hydrothermal methods were prepared. Sodium titanate nanotube composites decorated with N and S doped graphene quantum dots (NSGQD) are also prepared. A complete structural characterization of the different composites is presented (working with different mass fractions), by means of X-ray diffraction, GI-SAXS, AFM, Raman and HRTEM. In addition, a study of the electrical properties of the composites using impedance spectroscopy is presented, revealing an active improvement in the electrical conductivity of the composites compared to undecorated nanotubes. Pre-eliminary tests in QDSSC-type cells are also explored, studying the transport dynamics by means of impedance spectroscopy and IMVS and IMPS spectroscopy.

References.

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