Preliminary results on the application of niobium-coated conductive CVD-grown diamond as counterelectrode material for DSCs

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Dye-sensitized solar cells (DSCs) comprise a promising solution as a renewable energy source, especially in view of its recent debut in the consumer electronics market. As a photoelectrochemical device, the counterelectrode (CE) plays an important role in regenerating oxidized species in the electrolyte, usually triiodide, to iodide, on its catalytic layer. Therefore, some properties of CEs are the catalytic activity toward redox mediators in the electrolyte and electrical conductivity in order to use electrons from the external circuit in the reduction of oxidized mediator molecules. The aim of this work is to apply, for the first time, a conducting diamond layer onto niobium (Nb) substrates as CE for DSCs. The conducting diamond layer was deposited onto Nb substrate by hot filament chemical vapor deposition (HFCVD). DSCs were based on quasi-solid state gel polymer electrolyte and ca. 10-µm-thick TiO_2 layer sensitized by the N-719 dye. Current-voltage (I-V) curves were measured under 100 mW cm^{-2} (AM1.5) at a Sciencetech solar simulator (class AAA). Raman spectroscopy data has evidenced the growth of diamond layers. Surface roughness was observed by scanning electron microscopy (SEM) images, corroborating the growth of nanostructured diamond layers. Excellent electrical parameters were observed from I-V curve measurements, with a power conversion efficiency of 1.6% under one sun illumination. In light of this promising performance result, further research is underway in our laboratories in order to optimize the solar cells with this novel CE material.