Low-cost TCO Less Counter Electrodes for Dye-sensitized Solar Cell Application

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Dye-sensitised solar cells (DSC) [1] are a special class of photoelectrochemical device where direct conversion of light energy into electrical energy is taking place aided by a photosensitive dye adsorbed onto a wide band gap semiconductor material. A redox electrolyte, platinum catalyst and a pair of electrodes are the other essential components of this device where electrodes in particular are normally transparent conductive oxide (TCO) based which are produced through an expensive fabrication route. Hence, in order to reduce the cost of manufacturing and to make the process viable in terms of industrialization, cheap alternatives are required. Therefore, the development of transparent conductive oxide (TCO) less [2] counters electrode substrates for dye-sensitized solar cells (DSC) are an important development area in photovoltaics which will significantly reduce the device fabrication cost. The currently used TCO layers can be replaced with more conductive and robust coatings on a wide range of conducting and non-conducting substrates such as metals and soda glass.

This paper introduces a new counter electrode design featuring a platinised organic-inorganic coating (Figure1) based on titanium nitride and polyimide. The coating presented here involves the incorporation of electrically conductive titanium nitride (TiN) particles into a polyimide matrix producing a film with comparative resistivity to typical TCO materials whilst providing dimensional stability and corrosion resistance [3] to the aggressive I^-/I_3^- electrolyte [4]. Catalytic performance is presented and compared to standard FTO coated glass substrates (Figure 2). It is however essential to mention in this case that all fabricated DSCs were forward illuminated with no scope for the reverse illumination as the developed coating was completely opaque in nature.

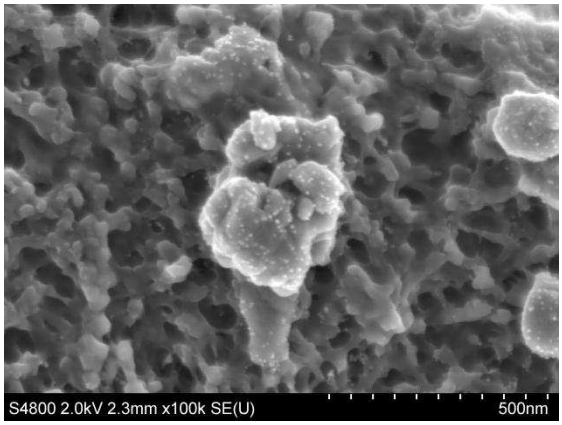

Fig 1: Scanning electron micrograph of a platinised coating

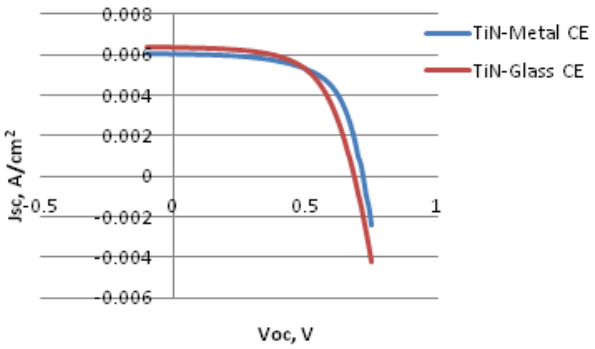

Fig 2: Photovoltaic behaviour of TiN coated metal and glass counter electrodes (CE's).

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