An Inorganic/Organic Hybrid Coating for Low Cost Metal Mounted Dye Sensitized Solar Cells

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Titanium metal mounted dye-sensitized solar cells [1] (DSC) have previously displayed over 7% photoconversion efficiency [2]. Attractive physical as well as superior corrosion resistant properties vindicate Ti-metal's suitability as the best substrate for metal based reverse illuminated DSC's, unfortunately the higher cost of titanium as compared to widely used ferrous alloys poses a question on its compatibility as a low-cost substrate material for roll-to-roll DSC production [3] in order to commercialize the technology. This issue has been addressed in this paper where a low-cost metallic/polymer hybrid coating system capable of withstanding sintering temperatures is presented as an alternative to titanium based flexible or rigid TCO coated glass DSCs.

Titanium nitride (TiN) incorporated polyimide (PI) is an inorganic/organic type hybrid coating where TiN particles are evenly dispersed into a polyimide system (Figure 1) suitable for coating on various substrates. The cured TiN/PI composite coating can withstand high temperatures (up to 500°C) whilst maintaining excellent dimensional stability and electrical conductivity, with resistivity values as low as transparent conducting oxides (Figure 2). This allows the titanium dioxide to be deposited and sintered whilst maintaining substrate integrity. In addition, the corrosion resistant nature of TiN [4] and polyimide enable this coating to form a chemically protective barrier for flexible metallic substrates preventing corrosion from the aggressive I^-/I_3^- electrolyte whilst maintaining electrical conductivity [5].

DSC's fabricated using such a coating on architectural steel substrates demonstrate similar photovoltaic characteristics to Ti-metal based cells under the same experimental conditions. This work has the potential to enable deployment of large area dye-sensitized solar cell photovoltaics on low cost mass produced construction steel substrates.

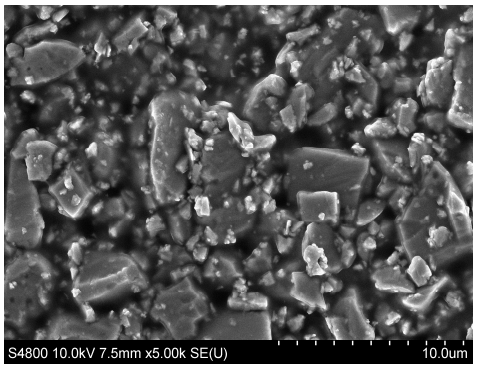

Fig 1: Scanning electron micrograph of the coating (heat treated at 450°C)

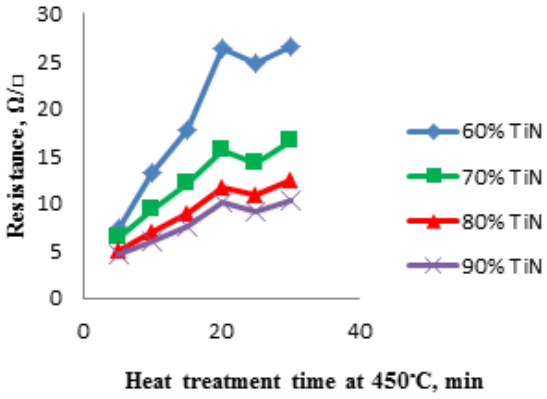

Fig 2: Coating sheet resistance v. heat treatment time at 450°C

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