PO1038

Ambient Air Plasma Processing of Inkjet Printed Mesoporous TiO2 Flexible Photoanodes

Tomáš Homola[1], Petr Dzik[2]

[1]Masaryk University, Brno, Czech Republic [2]Brno University of Technology, Brno, Czech Republic

tomas.homola@mail.muni.cz

Flexible and printed photovoltaics can contribute greatly to increasing global access to cheap energy. Dye-sensitized solar cells (DSSC) and perovskite solar cells, in which the photo-electrochemical system relies upon a mesoporous crystalline TiO_2 layer, have emerged as a promising low-cost photovoltaic technology and constitute a notable application field for semiconducting photoanodes. Fine mesoporous TiO_2 films are usually cured at high temperatures by means of a slow convection heating procedure (at least 30 min above 350 °C) in order reliably to remove all organic components present in the coating formulation. The high sintering temperature, however, precludes the use of such a procedure for thermally sensitive and flexible substrates and results in performance deterioration in transparent conducting oxide substrates.

We prepared hybrid mesoporous titania/silica electron-generating and transporting layers using wet coating with a dispersion consisting of prefabricated titania nanoparticles and a methyl-silica binder. Titania/methyl-silica wet layers were deposited by inkjet printing on ITO/PET flexible foils and further mineralized by low-temperature (70 °C) atmospheric-pressure air plasma using diffuse coplanar surface barrier discharge (DCSBD) to form a titania/silica hybrid nanocomposite coating.

The plasma mineralization process provides production performance superior to the previously-considered processes (thermal sintering and UV curing), taking only a fraction of the time required for them at far lower temperatures. The coating can be applied on flexible polymer which makes the application suitable for fast roll-to-roll fabrication units. The reported method could constitute a major step forward in the large-scale manufacture of low-cost flexible functional coatings.

Keywords
plasma treatment
flexible and printed electronics
roll-to-roll
mesoporous coating
ambient air diffuse plasma