Characterization of novel platinum-free nanostructured gold counter electrode for DSSCs prepared by pulsed laser ablation

S. Gullace[1,2], F. Nastasi[2], F. Puntoriero[2], S. Trusso[1,*] and G. Calogero[1]

[1]IPCF-CNR, Istituto per i Processi Chimico-Fisici, V.le F. S. d'Alcontres 37, 98158, Messina Italy.

[2]Department of Chemical, Biological, Pharmaceutical and Environmental Sciences, University of Messina, V.le F. S. d'Alcontres 31, 98166, Messina, Italy.

*corresponding author: trusso@ipcf.cnr.it

Gold nanostructured thin film has been deposited on fluorine-doped tin oxide (FTO) glass substrate by a pulsed laser ablation (PLA) technique to supersede the catalytic activity of platinum towards iodine-free redox mediators in dye-sensitized solar cells (DSSCs). The DSSCs is composed by a TiO_2 photoanode sensitized with the Y123 dye, Co(II)/Co(III) based electrolyte and nanostructured gold counter electrode (CE). For comparison, platinum and gold CEs have been prepared by thermal decomposition of H_2PtCl_6 and $HAuCl_4$, respectively. The CEs were characterized by SEM, UV-Vis spectroscopy and square wave voltammetry. The CEs showed very different surface morphologies: on the Pt CEs surface small isolated NPs are visible, most of them having size of 1-2 nm or less, while thermally grown Au CEs exhibited larger but still isolated NPs. Au PLA CEs, on the contrary, present a nearly uniform coverage of the substrate surface by nanostructured gold islands separated by narrow gaps (see Fig1). DSSCs based with Au PLA CEs, comparable I-V performance to the device with the conventional Pt CE. PLA is a promising way to fabricate transparent and high-performance Pt-free CEs for future large-scale applications not only in photovoltaics but even for others devices employing gold for catalysis, sensing, opto-electronics.

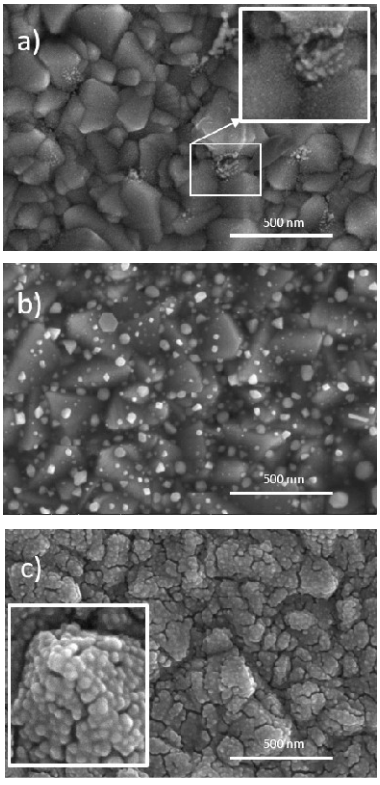

Fig.1 Surface morphologies of the a) Pt b) Au therm and c) Au PLA counter electrodes.