ELECTROPHORETIC DEPOSITION OF NANOPARTICLES FOR PHOTO-THERMAL SOLAR RECEPTORS

Guillaume Toquer, ICSM, CEA/CNRS/ENSCM/UM, UMR 5257, 30207 Bagnols-sur-Ceze, France
guillaume.toquer@enscm.fr
Sanaa Shehayeb, ICSM, CEA/CNRS/ENSCM/UM, UMR 5257, 30207 Bagnols-sur-Ceze, France
Xavier Deschanels, ICSM, CEA/CNRS/ENSCM/UM, UMR 5257, 30207 Bagnols-sur-Ceze, France
Iyad Karamé, Lab Organometall Catalysis & Coordinat Chem, Lebanese University, Beirut, Lebanon

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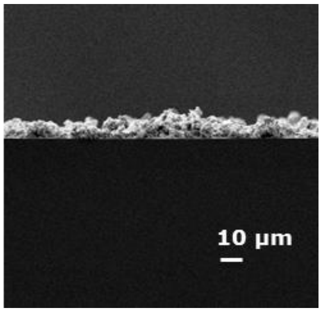
The production of hot water by using efficient photothermal solar collectors is growing in importance to limit the use of fossil fuels. Such surfaces have to display a high solar absorptance (α>0.9), in the UV-VIS and near-IR regions (0.5-2µm) with a low thermal emittance (Ɛ<0.1), in the mid-far infrared region (2-20µm) [1]. Black copper (CuO) has proved to be one of the viable solar-selective coatings owing to its nearly intrinsic properties with high solar absorptance (α>0.9) and comparable emittance (Ɛ<0.4). This study investigates the electrophoretic deposition (EPD) of dispersed nanoparticles (CuO) for the formation of submicron coating as a selective solar absorber [2]. To enhance the native CuO optical properties, a tandem system composed of CuO thin film deposited onto a highly IR reflecting metallic substrate (*i.e.* gold silicon wafer) is formed by electrophoretic deposition (EPD). Pure CuO thin films are obtained from EPD with a thickness control which is the key to drive the final optical properties. Prior to the electrophoretic deposition, the colloidal dispersion is analysed by laser doppler velocimetry coupled with small angle X-ray (SAXS) and dynamic light scatterings (DLS). The colloidal stability results mainly from Van der Waals and electro-steric interactions, which is a crucial factor in order to obtain some homogeneous and uniform films. Indeed, it not only affects the particle migration, but also influences the green coating density. Besides, some stabilizer additives as $MgNO_3$ are also embedded during the EPD in order to modulate the density of the coating by acting as a binder. The deposition yield is studied relative to the different applied voltage range, deposition time and nanoparticle concentrations. The composition and the thickness of the coatings are analysed by X-ray diffraction (XRD), scanning electron microscopy (SEM) and energy-dispersive X-ray spectroscopy [3]. Finally, their optical selectivity thresholds are determined by reflectance spectroscopy from UV-vis-NIR spectra and Fourier transform (FTIR) spectra. The associated optimal film thickness range is finally discussed according to the EPD experimental conditions.



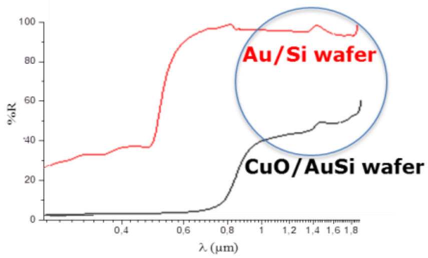


Figure 1 – (left): Scanning electronic microscopy picture of the cross section CuO film. (right): Reflectance spectra (visible infra-red) from the CuO coating on gold silicon wafer

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