Mesoscale porous inverse opals: characterization of their charge and ion transport properties for photoelectrochemical electrode application

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Inverse opal (IO) films with mesoporous structures hold promise as high-performance electrodes for various photoelectrochemical devices because of their high specific area as well as their fully connected pore structure. A great challenge to their use is obtaining an intact film of mesoscale colloidal crystals as a template. We demonstrate that a TiO2 mesoscale IO (meso-IO) with sub 100 nm pores is fabricated by using mesoscale colloidal crystals and chemical vapor deposition of TiO2. The charge transport properties of the meso-IO TiO2 films are characterized using the intensity-modulated voltage spectroscopy (IMVS) and intensity-modulated photocurrent spectroscopy (IMPS) techniques. We also characterize the ion diffusivity the meso-IO TiO2 film using the modified Fick's law with the diffusion-limiting current in the current-voltage characteristic.