271h Using Photoelectrochemical Probes to Investigate the Pore Accessibility in Surfactant-Templated Ordered Mesoporous Thin Films

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Surfactant templated mesoporous materials[1] have received a lot of attention in the scientific community for their potential applications in catalysis, adsorption and separations. Recently, novel applications of non-silica mesoporous metal oxides such as TiO_2, SnO_2 and ZnO in photovoltaics and photocatalysis have attracted a great deal of synthesis effort to create novel architectures of these metal oxides.[2] However, in order to realize their use in devices such as dye sensitized solar cells, gas sensors and as templates for electrodeposition to create nanocomposite materials, it is essential that the pore systems in these materials be accessible to the species of interest (e.g. dye molecules).

Here we report our investigations into the accessibility of the pore systems in block copolymer templated ordered mesoporous TiO_2 and SnO_2 thin films using organic molecules as probes. Photo-generated holes in both TiO_2 and SnO_2 are very strong oxidizing agents.[3] The use of TiO_2-based materials (nanoparticles, films) for photo-oxidation of organic molecules has been well-documented in the literature.[3,4] Here we use organic molecules as probes to determine the area accessible for photo-oxidation. Organic molecules are first adsorbed on both porous and non-porous metal oxide thin films. Then the films are transferred to a photoelectrochemical cell and the organic molecules are oxidized by illuminating the films with UV radiation. The photocurrent resulting from the oxidation of the organic molecules is measured to get the amount of the probe adsorbed on the metal oxide surface. This method allows one to determine the adsorption isotherms for organic probes on metal oxide surfaces and obtain the amount required for monolayer coverage.[4] Thus, a quantitative estimate of the accessible photo-active area can be made. A good estimate of the cut-off size of the pores for the organic molecules can be made by measuring the adsorption isotherms for probes of different sizes.

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