"Electrodeposition of Mesoporous Silica on 3-D substrates for Formation of Ultrahigh Surface Area Electrodes",

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Extremely high surface are porous electrodes are of interest as current collectors for advanced batteries, and as the basis for supercapacitors. For moderate to large scale storage applications a three-dimensional material is needed with porosity at multiple length scales. We are developing a combined bottom up/top down approach to creating such materials by using electrodeposition of mesoporous silica on nickel foam, a commercially available porous conductor widely used as the current collector in various batteries. Electrodeposition produces a conformal coating on the nickel foam. By controlling the electrodeposition time the morphology of the mesoporous silica can be varied from a thin film up to 500 nm thick to a loosely bound agglomeration of mesoporous silica particles capable of completely filling the 0.3-0.5 mm voids of the nickel foam. Post treatment with base is sufficient to crosslink the mesoporous silica particles and provide a composite with some mechanical robustness. The internal diameter of the mesopores in the silica can be controlled in the range 3.2-4.6 nm by changing the chain length of the templating surfactant used. Gas adsorption shows surface areas of 600-1000 m^2/g of silica deposited, consistent with the assumed structure of the material. Preliminary experiments with electrodepositing nickel into the pores in the mesoporous silica, and in the voids between particles to form a high surface area, hierarchically porous conductor are on-going.