"Electrodeposition of Mesoporous Silica on 3-D substrates for Formation of Ultrahigh Surface Area Electrodes",
Nikolas L. Cordes and Martin G. Bakker, Department of Chemistry and Center for Materials for Information Technology

Extremely high surface area 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 m²/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.