"Formation of High Surface Area Porous Metal Monoliths by Nanocasting",
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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 an integrated method of forming hierarchically porous electrodes that are bicontinuous at multiple length scales. This uses nanocasting of metal into hierarchically porous silica monolith templates. By judicious control of the nanocasting approach we can produce negative replicas of the mesostructure and positive replicas of the macrostructure of the monolith. This results in high surface cobalt, nickel and silver replicas. The silica templates typically have surface areas of 600-1200 m^2/g silica, corresponding to 1300-2500 m^2/mL silica. For cobalt we have achieved surface areas of 65 m^2/g cobalt or 550 m^2/mL cobalt. The lower effective surface area of the cobalt replica may well reflect the more crystalline nature of the cobalt compared with the amorphous nature of the silica. The crystallinity would be expected to be result in a lower surface area, since it will smooth out microporosity in the silica. The starting silica template has mesopores produced by incorporation of cationic surfactants and so has a narrow pore size distribution. The mesopores in the silica template are not ordered and replication gives a relatively broad pore size distribution in the metal replica as anticipated.