Highly ordered macroporous magnetic materials prepared by electrodeposition through colloidal template

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We report an electrochemical technique for the preparation of macroporous magnetic materials with highly ordered spherical voids. The interstitial sites in close-packed arrays of colloidal silica with an average diameter of 300 nm, prepared by modifying the literature method [1, 2], were filled by the electrodeposition of Fe, Co, Ni, Fe_3O_4. For metal deposition, the electrodes were immersed into metal plating solutions with a gold counter electrode. Electrodeposition was carried out in a constant potential in which a low current density (0.50 mA/cm^2) was used in an effort to achieve uniform deposition. The silica templates were removed by soaking the deposited templates into a 2 % HF solution for 10 h. Fig. 1 shows a typical SEM image of the template-free macroporous Fe film, which consists of spherical voids arranged in a three dimensionally ordered close-packed structure. The voids have the almost same diameter as the silica spheres used to form the template and are interconnected through smaller channels. Macroporous ferrite film is also obtained by electrodeposition from aqueous solution of 0.058 g of KCH_3COO and 0.1176 g of $(NH_4)_2Fe(SO_4)_2 \cdot 6H_2O$ to 30 mL of D.I. water at 90 °C under vigorous stirring. The ferrite framework is fragile whereas the metallic ones are dense and self-supporting. Due to the nano-sized network features, the magnetic properties of the four macroporous magnetic materials prepared by electrodeposition are different from their corresponding bulk materials.

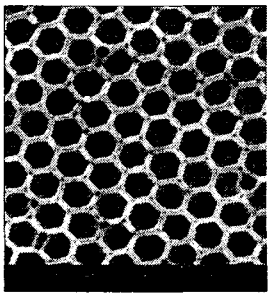

Fig.1. SEM image of Fe mesh

References

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