Properties of Nanocrystalline Nickel Particles in Ni-SiO_2 Composites

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Nickel-Silica nanocomposites with a nickel content equal to 10, 15, 20 wt% have been prepared by a sol-gel method starting from ethanolic solutions of tetraethoxysilane and nickel nitrate hexahydrate. After gelation the samples were reduced in H_2 flow at selected temperature (450 °C < T < 600 °C).

The morphological, structural and magnetic properties were investigated by transmission electron microscopy (TEM), wide and small angle X-ray scattering (WAXS, SAXS), magnetic susceptibility in zero field cooled and field cooled mode (ZFC and FC), and magnetic hysteresis loop.

Nanometric nickel particles are observed in all the investigated samples. TEM, WAXS and SAXS techniques indicate that the average nickel particle size grows slightly but almost regularly with the nickel concentration. TEM results moreover indicate that also the width of the particle size distribution, which can be simulated by log-normal functions, follows this trend.

All the sample treated in hydrogen show superparamagnetic behaviour. The magnetisation falls to reach saturation up to highest measuring field of 70 kOe even at 3 K, while the observed coercivity H_C is much higher than the theoretical bulk one. Some uncertainty in the complete interpretation of the sequence of magnetic measurements is attributed to a progressive oxidation of the samples when these are air exposed.

Key words: Nanocomposites; Nickel-Silica; X-ray Diffraction; TEM; Magnetic Properties.