Structure and magnetic properties of Ni- doped gehlenite glass microspheres

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The structural and magnetic properties of undoped and Ni-doped aluminate glass microspheres with gehlenite composition and of their polycrystalline analogues were studied. The concentration of Ni was 0.5, 1 and 3 mol. % . Glass microspheres were prepared by combination of solid-state reaction and flame synthesis. The detailed examination of morphology of the glass microspheres of all prepared composition by scanning electron microscopy (SEM) revealed no features indicating presence of crystalline phases. However, except of the sample GNi3.0 (3.0 mol. % of Ni), X-ray powder diffraction (XRD) detected traces of crystalline gehlenite in all other compositions. In samples crystallized at 1273 K for 10 h, XRD revealed the presence of gehlenite as the only crystalline phase. The finding was supported by SEM examination, which revealed morphological features characteristic for crystals. Raman spectroscopy of crystallized samples also confirmed the presence of gehlenite. Raman spectra of as-prepared glass microspheres differed significantly from the spectra of their crystallized counterparts. These indicate the role of aluminum as a network-forming element. Magnetic properties of the undoped and Ni-doped gehlenite microspheres and of their polycrystalline analogues were measured by Quantum Design SQUID magnetometer. Measurements showed complex magnetic behaviour of prepared glass microspheres, influenced by temperature, the magnetic field and content of Ni. The samples were diamagnetic or weakly ferromagnetic at 300 K, whereas paramagnetic or weak ferromagnetic behaviour was observed at 2 K. The influence of crystallization on magnetic properties was also investigated.

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