PREPARATION AND PROPERTIES OF Fe AND Fe_3O_4 NANOPARTICLES EMBEDDED IN ZrO_2 MATRIX

P. Roupcová[1, 2] and O. Schneeweiss[1]

[1] Institute of Physics of Materials ASCR, Czech Republic

[2] Institute of Materials Engineering, Brno University of Technology, Czech Republic

The (Zr, ZrO_2)-(Fe, Fe_3O_4) nanocomposites are investigated due to their magnetic properties and resistance against negative influence of the surrounding atmosphere namely at elevated temperatures. The particles of pure Zr and its intermetallic phases can effect as a getter protecting the iron particles against oxidation.

We have investigated behaviour of the nanocrystalline powders prepared as a mixture from pure components. TEM and XRD were explored for standard phase composition and determination of the main particle size. Mössbauer spectra were collected by a standard transmission method at room temperature using ^{57}Co/Rh source. Magnetic measurements were carried out using vibrating sample magnetometer at high temperature at (293÷1093) K, in the vacuum (10^{-1} Pa) and in the pure hydrogen (5N) atmosphere.

The structure study showed that as-prepared samples consist of Fe_3O_4 particles with the mean coherent length ~30 nm as determined by XRD which increased during the heat treatment up to ~50÷100 nm. The samples annealed in vacuum were formed by particles of ZrO_2-monoclinic, ZrO_2-tetragonal and ZrO_2-cubic and iron oxide (α-Fe_2O_3, Fe_3O_4 and FeO) phases. The annealing in hydrogen caused reduction of iron oxides to pure iron particles and clusters in ZrO_2. The magnetic parameters confirm full transformation of iron oxides to bcc iron.