Nanocomposites and nanomaterials

Low temperature sintering of REM-TM ferromagnetic materials

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The permanent magnets based on alloys of rare earth and transition metals are important components of the electric motors of eco-friendly ground and air transport, the wind electric generators. Nanostructuring is way of improving magnets properties. Nanocomposites – the mixture of ferromagnetic soft and ferromagnetic hard phases – will have energy product two times higher than modern.

The basics of sintering under hydrogen were developed for their production.

Scanning electron microscopy (JSM-6490 LV), X-ray energy dispersive spectrometry (INCA Penta FET3) and X-ray phase (DRON-2.0M, Fe *K* radiation) analyses were used for the investigation materials based on $Nd_{16}Fe_{73.9}Zr_{2.1}B_8$, KC25 ($Sm_2Co_{17}$-type alloy), $Sm_2Co_{17-x}T_x$ (T=Zr; x=0.5 and 1.0; T=Ti, x=0.1 and 0.2) sintered under hydrogen and vacuum by hydrogenation, disproportionation, desorption, recombination (HDDR) route at low temperatures with obtaining nanostructure. The alloys were milled in the planetary mill with frequency 100-300 rpm during 1-12 h. The powders were pressed isostatically in magnetic field under 10 t/cm2 pressure. During sintering the hydrogen pressure was up to 1.5 MPa, temperature up to 950 ºC.

It was found the treated powders are sintered. The $Nd_{16}Fe_{73.9}Zr_{2.1}B_8$-based sintered materials have porosity up to 2.6 % vol. and microstructure grain size 90-150 nm. The $Sm_2(Co,T)_{17}$-based sintered materials have porosity up to 3.1 % vol. and grain size from 70-145 to 120-190 nm.