Proceedings of the 5th International Conference on Nanotechnology: Fundamentals and Applications
Prague, Czech Republic, August 11-13, 2014
Paper No. 104

Nanostructured Magnetic Oxides Potential for Infrared Applications

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Extended Abstract

Nanostructured magnetic oxides are being intensively investigated due to both the fundamental problems of the physics of nanocrystalline magnetics and the prospects of their application use. Optical spectroscopy is an effective tool for studying the electronic structure of nanostructured oxides (Gizhevskii et al., 2006; Gizhevskii et al., 2005; Gizhevskii et al., 2009; Makhnev et al., 2010). Nanostructured manganites are promising to study due to earlier observed negative magnetotransmission and magnetoreflection of unpolarized infrared radiation (up to 50%) in manganite crystals and films (Mostovshchikova et al., 2013; Sukhorukov et al., 2002; Sukhorukov et al., 2003)

After the grinding the coarse-grain $Nd_{0.5}Sr_{0.5}MnO_3$ powder was placed between the anvils and pressed at 10 GPa. Shear deformation was achieved by rotating of the anvils (Telegin et al., 2012). The nanocomposites under study were prepared by easy pressing a mixture of $Nd_{0.5}Sr_{0.5}MnO_3$ nanopowder and dielectric material (Mostovshchikova et al., 2013). The prepared composites were transparent in the wide IR-spectral range and exhibit optical and magneto-optical characteristics comparable to the corresponding parameters for single crystals and films. Optical properties of the samples depended on the crystallite size, defects and the violation of stoichiometry of samples. Dispersion of the optical functions in nanostructured samples is different from that for single crystals: the intensity of low-energy electron transitions increases and new IR bands arise. But the main fundamental bands are the same as in the single crystals. It is worthy to notice, all the nanocomposites exhibited the giant change of the transmittance (magnetotransmission effect) near the Curie point (T_C). Peculiarities of the nanocomposites were the decreasing of T_C (and temperature of maximal MT value) and saving the large magnetotransmission ~7 % at the lowest temperatures. Magnetoreflection in $Nd_{0.5}Sr_{0.5}MnO_3$ nanoceramics reaches up to 1.5 % with weak frequency dependence in the wider spectral range in comparison with one for the single crystal. The reflection spectra of nanoceramics changed from polaron-like to the Drude-like behavior depending on the deformation. The observed features are discussed in the terms of the destroying of the magnetic and electronic states of samples under deformation and significant contribution of the nano-particle shells.

Acknowledgements

Supported by the Russian Megagrant № 2013-220-04-329, Russian scientific foundation, project RAS № 12-T-2-1005; and project UD-FED № 12-C-2-1026.

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