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Seção
Resumo em Proceedings

Ausência de interação de troca entre momentos magnéticos localizados e elétrons de condução em nano partículas de prata

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Resumo

Nanostructured materials are characterized by the existence of particles/ phases in the length scales between 1 and 100 nm range where size reduction effects may originate either unusual or different properties from the corresponding bulk materials [1]. In addition to their potential applications, fundamental physical aspects of these systems represent a fascinating issue to be tackled. In this paper we report details about the synthesis, structural and magnetic properties of the magnetic ions (RE = Er3+ , Yb3+ and Mn2+) diluted in Ag colloidal nanoparticles (RE concentration ≈ 5 %). These studies were carried out by means of Transmission Electron Microscopy (TEM), Small Angle X-Ray Scattering (SAXS), powder X-Ray Diffraction (XRD), dc-magnetization and Electron Spin Resonance (ESR) techniques. The microwave power dependence of the RE ESR intensity measured at 4.2 K for the three RE ions diluted in Ag nanoparticles (NPs) follows the linear square root power law up to 100 mW. The measured g-values for the metallic Ag:Er, Ag:Yb and Ag:Mn NPs are T-independent in the range of 4.2 K < T < 36 K. For the Ag:Er NPs the measured g-value of 6.74(4) is close to the Γ7 doublet ground state g-value reported for Er3+ in the cubic ThO2 insulating host [2]. In some bulk metallic hosts the Yb ions exhibit localized magnetic moment (Yb3+) (e.g., La, Au), but they are diamagnetic (Yb2+) in others (e.g., Mg, Ag) and, therefore, no ESR should be observable. However, and surprisingly, the Yb3+ ESR is observed in our metallic Ag:Yb NPs. In particular, the measured Yb3+ g-value of 3.43(4) corresponds to the g-value of a Γ7 doublet ground state found in cubic insulators. For the Ag:Mn system the g-value for both bulk and NPs samples are about the same for T > 15 K, g ≈ 2.01. Usually the ESR intensity of diluted RE in bulk metallic alloys is hardly saturable even at very low-T. This is due to the fast relaxation of the localized magnetic moment to the lattice via the exchange interaction with the conduction-electrons (Korringa-mechanism). Our results give strong experimental

evidences for the existence of finite size effects on some of the ground state properties of the magnetic ions diluted in Ag NPs. The local field, the spin-lattice relaxation, the RKKY interaction, the strength of the cubic crystal electric field (CEF), were dramatically affected. These results suggest that in Ag:RE NPs the exchange interaction, Jf s S.s, is inoperative and the intensity of the cubic CEF is strongly enhanced.

Referências

[1] C. B. Murray, C. R. Kagan, M. G. Bawendi, Annu. Rev. Mater. Sci. 30, 545 (2000).

[2] A. Abraham, A. Weeks, G. W. Clark, C. B. Finch, Phys. Rev. 137, A138 (1965).