Dielectric properties of lead-barium zirconate titanate, alloyed with copper and nickel

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Piezoceramics are as a rule inorganic dielectrics with high value of dielectric permittivity depending on an electric field strength. Among these materials the most known are the ceramics based on $PbZrO_3$—$PbTiO_3$ (PZT) systems[1]. Piezomaterials based on PZT ceramics have widespread applications as electromechanical and electroacoustic transducers [1]. In this work we investigate the dielectric properties of Pb0.75Ba0.25Zr0.53Ti0.47O3 (PBZT) – metal nanocomposites in wide frequency range from 20 Hz – 1 MHz. The complex dielectric permittivity of all investigated composites at higher temperatures and low frequencies is mainly caused by the high electric conductivity, wich similarly to the pure PZT is mixed electronic-ionic. Only at the highest frequency - 1 MHz the real part of complex dielectric permittivity is much higher as imaginary part, therefore the dielectric permittivity at this frequency is static and can be fiited with Curie-Weiss law. Obtained Curie-Weiss law parameters indicate nearly the second order displacive phase transition driven by resonant soft mode in all investigated composites. The ferroelectric phase transition temperature is higher for composites with Ni addition and lower in composites with Cu addition in comparison with pure PBZT. Below the ferroelectric phase transition temperature the dielectric dispersion is mainly caused by ferroelectric domains dynamic. The activation energy of domains dynamics is lower in composites in comparison with pure PBZT, it can be explained by decreasing of domains size in PBZT composites.

[1] T. R. Shrout, S. J. Zhang, J Electoceram 19 (2007) 111.

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Reorientation of magnetization in a single-domain cobalt particle by a laser beam

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We have theoretically observed switching and oscillations of magnetization in a single domain nanodisk in a ferromagnet/non-magnetic metal/ferromagnet nanostructure being irradiated by laser pulses with linear and circular polarization. A macrospin approximation and the generalized Landau-Lifshitz-Gilbert equation were used. The interaction of the laser radiation with the ferromagnetic metal is supposed to be followed by: (i) the change the energy of magnetic crystallographic anisotropy, (ii) saturation of magnetization, (iii) generation of a spin-polarized current by photon pressure. Moreover, the circular-polarized laser radiation is considered to initiate the inverse magneto optical Faraday effect in the nanodisk. Switching of the magnetization of the nanodisk under linear-polarized laser radiation was found to be controlled by a change of the magnetic anisotropy energy due to heating of the nanostructure. This process is accompanied by oscillations of the magnetization with a frequency of 5 – 20 GHz damped within few to tens nanoseconds. Thermal fluctuations lead to an increase of both the damped period and the frequency of oscillation. In the case of the circular-polarized light irradiation the magnetic field arising from the inverse Faraday effect increases the frequency and amplitude of magnetization oscillations.

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