The 3rt International Baltic Conference on Magnetism

IBCM 2019

Book of Abstracts

Kaliningrad, Russia
18-22 August, 2019

International Baltic Conference on Magnetism:

nanobiomedicine and smart materials

Kaliningrad, Russia; August 18-22, 2019

IBCM 2019 is organized by Laboratory of Novel Magnetic Materials,

Institute of Physics, Mathematics and Information Technology,

Immanuel Kant Baltic Federal University

Main Topics:

- Magnetic materials for biomedicalapplications
- Manipulation of nanoparticles.Tweezers
- Hyperthermia
- Drug delivery
- Magnetic resonance imaging
- Magnetic particle imaging
- Microfluidics + nanoparticles
- Lab-on-a-chip
- Bio-sensors
- Modeling and simulation mehods
- Design of novel permanent magnets
- Magnetocaloric and multicaloric materials
- Phase transitions and magneticmaterials
- Multiphase and compositematerials
- Magnetostrictive and magnetoelasticmaterials

Magnetodeformation and electrodeformation as source ofmultiferroic properties in elastomers

L.A. MAKAROVA[a,b,*], A.S. KOMLEV[a], YU.A. ALEKHINA[a], M.F. KHAIRULLIN[a], A.S. OMELYANCHIK[b], V.V. RODIONOVA[b], O.V. MALYSHKINA[c], N.S. PEROV[a,b]

[a]Lomonosov Moscow State University, 119991, Leninskie gory 1, Moscow, Russia

[b]Immanuel Kant Baltic Federal University, 236004, Nevskogo 14, Kaliningrad, Russia

[C]Tver State University, 170100, Zhelyabova 33, Tver', Russia

***** la.loginova@physics.msu.ru

Magnetorheological and electrorheological composites, particularly elastomers, attract the researcher attention due to their tunable properties and ease in utilization. The huge magnetodeformation and electrodefromation effects, correspondingly, lead to great opportunities for the development of new composite materials based on them with promising properties.

Composite materials based on silicone, ferroelectric (FE) and ferromagnetic (FM) components were investigated. To determine the contribution of FE component to the properties of composite sample there were used two types of FE particles – PZT microparticles and BFO nanoparticles. PZT particles were obtained by ball milling of bulk ultrasonic element. BFO particles were prepared via sol-gel method with annealing at the temperature of 650 C during 2 or 12 hours. To determine the FM particle moveability in the silicone two types of particles were used – iron microparticles (Fe) and cobalt ferrite nanoparticles (Co-Fe). Co-Fe particles were also prepared via sol-gel method with annealing at the temperature range 300-500 C during 1 h.

The following samples were prepared from silicone and above mentioned components for the investigations: 1) pressed tablets from FE particles with average diameter 6 mm and thickness 1 mm; 2) composites based on silicone and one type of FE or FM particles – magnetorheological (MRE) of electrorheological (ERE) elastomers; 3) composites based on silicone and some mixture of FM and FE particles – multiferroic rheological elastomers (MfRE); 4) composites based on FE porous structure (based on ERE) filled with MRE – multiferroic rheological foams (MfRF).

The sizes of the particles were determined by TEM. The magnetic properties were measured by VSM LakeShore (model 7400) at the fields up to 16 kOe at the temperature range from 80 K to 300 K. The temperature investigations allow to find out the contribution of FM particle movement to magnetic properties of MRE. The ferroelectric hysteresis loops were investigated by Soyer-Tauer method with modifying cell with DC magnetic field.

The contribution of FE particles to the polarization properties of the samples, the moveability of FM and FE particles in silicone matrix under magnetic or electric field, the mechanisms of magnetoelectric transformations in MfRE and MfRF are discussed in the work. Such mechanisms differ for multiferroic elastomers and multiferroic foams. In the first case the magnetoelectric coupling is associated with movements of FE and FM particles in uniform silicone matrix. In the second case this coupling is associated with deformations of silicone pore walls with FE particles and filling MRE with FM particles.

The proposed research allows to improve the existing and to find new properties of composite materials based on rheological elastomers for their further prospective applications.

Financial Support of RFBR Grants No. 18-32-00354, 18-32-20219 is acknowledged.