**Magnetic fluids in electric fields: from structural changes to impedance transitions.**

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**Abstract.** In this talk, it will be demonstrated that besides the well-known effects of magnetic fields on magnetic fluid structure, the external electric forces can induce noticeable structural changes too. Particularly, we report on formation of visually observable patterns in a diluted low-polarity magnetic fluid exposed to external electric fields. The patterns are considered to be driven by a combined effect of electrohydrodynamics and electrical body forces. The free charge and permittivity variation are considered to play a key role in the observed phenomenon. The corresponding changes in the magnetic fluid structure are found at nanoscale as well. By small-angle neutron scattering (SANS) we show that the magnetic nanoparticles aggregate in direct current (dc) electric field with a strong dependence on the field intensity. The anisotropic aggregates preferably orient in the direction of the applied electric field. Then, analogous to the magneto-dielectric effect, a question is raised concerning the effect of the dc bias electric field on the nanofluid permittivity in a wide frequency range. We present dielectric spectra (1 mHz–1 MHz) measured on a base liquid (transformer oil) and magnetic fluid at various temperatures. Electrode polarization effect and an interfacial relaxation process are found. We show that the applied dc bias voltage results in permittivity sign switching at low frequencies. The critical frequency at which the sign is reversed depends on the temperature and the dc bias voltage level. The nanoparticle assembly and conductive percolative paths are considered as key mechanisms leading to the transition from capacitive to inductive reactance. Finally, it will be concluded that the measurement of apparent negative permittivity of magnetic fluid in a dc electric field can be used as a simple method for the detection of electric field-induced particle assembly and percolation. The permittivity sign control by means of a dc bias voltage may open an alternative avenue for research and applications of magnetic fluids.

**Michal Rajňák, Ph.D.** received his M.S. degree in Teacher training of Physics and Technical education from Prešov University of Prešov in 2011. Then, he followed a four year PhD study in Physics of Condensed Matter at Pavol Jozef Šafarik University in Košice. Since September 2015 he has been working at Institute of Experimental Physics SAS, Košice, as a young researcher. His main research interest is focused on experimental study of magnetic, dielectric and thermal properties of magnetic fluids for electrical engineering applications. During his PhD study he accomplished several short term scientific missions at neutron experimental facilities, dielectric spectroscopy and heat transfer oriented laboratories. Currently he is engaged in a research project oriented on novel magnetic fluids for cooling and insulating of power transformers.