Program of the Symposium on October 12, 2016 devoted to the scientific achievements of Professor Ritta Szymczak

Institute of Physics, Polish Academy of Sciences

Al. Lotników 32/46, 02-668 Warsaw

Hall 203, main building, 2nd floor

10:00 – 10:15

Prof. Andrzej Wiśniewski, Institute of Physics PAS, Warsaw

Scientific career of Prof. Ritta Szymczak

The brief summary of scientific career of Prof. Ritta Szymczak will be given, including some important dates and statistics. Since her scientific interests were very broad, some fields of activity, which will be not discussed in details in the following lectures, will be briefly mentioned. This includes, e.g., studies of phase transitions in oxide magnetic materials, basic properties of bulk superconductors, frustrated magnetic systems.

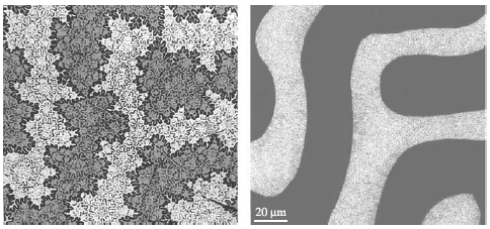
10:15 – 10:45

Prof. Andrzej Maziewski, Department of Physics, University of Bialystok, Bialystok

R. Szymczak – importance, variety and beauty of magnetic domains studies

A review of selected works by R. Szymczak on magnetic domains structures, and their influence on some branches of present research in magnetism, will be presented. Among others, it will be considered, developed by her, models of closure domains, which appear with increase of the sample thickness. Her excellent experiments, combining Bitter technique and the Faraday effect method in infrared light for visualization of magnetic domains (see the left and right hand side figures), have enabled a comparison of both internal and surface magnetization distributions. A deep physical analysis of unexpected experimental results done by R. Szymczak and her coworkers, had enabled to propose a new low-temperature-Bitter-technique designed for imaging of domain structures. R. Szymczak had intensively studied magnetic ordering in regions of phase transitions between: (i) ordered and disordered states at the Curie temperature, where magnetic domains walls, in which magnetization value changes across the wall have been discovered, and (ii) weakly ferromagnetic and antiferromagnetic states for systems with Dzialoshinski-Moriya interactions. She had also showed possibility of visualization of the magnetic flux penetration into superconductors by investigation of changes of the domain structure of a garnet film placed on a surface of the superconductor. Results of R. Szymczak's studies are often cited in modern handbooks on magnetism, e.g., figures presented below are taken

from the handbook **Magnetic Domains** by A.Hubert and R.Schäfer, Springer-Verlag (1998). Selected recent results related to R.Szymczak's investigations will be presented, for example: (a) micromagnetic simulations of spatial distribution of magnetization in nanometer-thick metallic layers; (b) surface/volume magnetization distribution in garnet slabs; (c) ultrafast magnetization dynamics in $DyFeO_3$ close to the Morin temperature.



10:45 – 11:15

Prof. Piotr Przysłupski, Institute of Physics PAS, Warsaw

Domain wall superconductivity

Prof. Rita Szymczak was engaged in study of many physical experiments. One of them are works performed in cooperation with Prof. Moshchalkov from Leuven University. They studied competition of superconductivity and ferromagnetism in heterostructures composed of niobium thin films deposited on iron garnet substrates ($Nb/Si/BaFe_{12}O_{19}$). Using this type heterostructures in series of experiments they studied so called domain type superconductivity. The authors demonstrate an appearance of domain wall superconductivity (DWS) in zero external magnetic field. Depending on the temperature range and the value of the external field H_{ext}, different behavior of such S/F hybrids is anticipated. Rather close to the superconducting phase transition line, when the superconducting state is only weakly developed, the magnetization of the ferromagnet is solely determined by the magnetic history of the system and it is not influenced by the field generated by the supercurrents. In contrast to that, the nonuniform magnetic field pattern, induced by the ferromagnet, strongly affects the nucleation of superconductivity, leading to an exotic dependence of the critical temperature T_c on H_{ext}. The experiments show also direct visualization of the DWS.

11:15 – 11:45

Coffe break

11:45 – 12:15

Prof. Igor Troyanchuk, Scientic-Practical Materials Research Center of National Academy of Sciences of Belarus, Minsk

Magnetic interactions in mixed valence perovskites

A large number of homovalent and mixed valent manganites and cobaltites with perovskite structure have been studied using magnetization, magnetoresistance and powder neutron diffraction measurements. It was shown that magnetic and magnetotransport properties can be described in superexchage model which is good alternative to double exchange model. In superexchange model ferromagnetic state results from positive interactions Mn^{3+}-O- Mn^{3+} (Mn^{3+}-O-Mn^{4+}) or between cobalt ions in intermediate spin state. Antiferromagnet–ferromagnet transition (spin state transition in cobaltites) induced by external magnetic field leads to effect of colossal magnetoresistance.

12:15 – 12:45

Piotr Pawlik, Jerzy J. Wysłocki, Bolesław Wysłocki, Institute of Physics, Częstochowa University of Technology, Częstochowa

Development of new manufacturing techniques for tailoring the magnetic properties of modern magnetic materials

Demand for materials revealing special physical properties stimulates development of new processing techniques and compositions of alloys. Another factor that promotes this development is reduction of manufacturing costs. At the Częstochowa University of Technology (IF-CUT) we are trying to face these problems of modern world by implementing now technologies of magnetic materials processing. The studies are focused on glass forming abilities and magnetic properties of iron based alloys. In the processing of amorphous samples the melt-spinning, injection casting and suction casting techniques are used. Appropriate alloying allowed to produce up to 3 mm diameter fully glassy rods. By adjustment of the processing route it was possible to cast 1, 2 and 3 mm outer diameter fully glassy tube samples by suction casting. Interesting studies are focused on production of RE-Fe-B alloys, that combine both good glass forming abilities and possibilities to shape their magnetic properties by devitrification annealing. Application of rapid solidification techniques to produce bulk glassy alloys as precursors of magnets results in significant reduction of manufacturing costs and possibilities of shaping the final products (such as miniature ring magnets) in a single stage process. The advantage of this technique is a possibility of manufacturing nanocrystalline composite magnets. In the talk some achievement in this field at IF-CUT will be presented. Another subject of interest at IF-CUT in the field of magnetism are magnetocaloric alloys. The La-Fe-Si-type alloys reveal relatively high magnetic entropy change ΔS_M around the phase transition at moderate changes of external magnetic fields H. ΔS_M in the $La(Fe, Si)_{13}$ alloy can reach even 31 J/(kg K) around the T_C of 185 K at the change of magnetic field of 5 T. The advantage of this group of alloys is a possibility of tuning their phase transition temperature by appropriate alloying in order to

utilize them at magnetic refrigerators that could replace household devices that base on gas transformations.

Recently, preliminary studies have started in the field of application of the iron oxide nanoparticles in the magnetic hypertermia as an alternative method of tumor treatment.

12:45 - ……

Discussion, complementary information, commemoration.