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BRIEF DESCRIPTION OF THE UNIT / RESEARCH GROUP

The main focus of the research activities of the Institute for Micro Production Technology is the design and manufacture of—especially based on magnetic effects—actuators and sensors (MEMS—Micro Electro Mechanical Systems), mechanical processing and characterization of MEMS and MEMS materials and the determination and adjustment of tribological properties. Development activities range from magnetic field sensors to measurement systems and micro motors, actuators to manipulation of micro-optical lens systems, and to biomedical applications.

Available to the scientific and technical staff of the IMPT for research activities is a class ISO 5 clean room, which, with its extensive facilities, allows for the implementation of microsystem processes for the production and analysis of MEMS and reliability studies. In addition, the IMPT has access to research laboratories, with which the mechanical processing and metrological characterization of microtechnical systems and materials are made possible. Therefore, IMPT is well integrated into the comprehensive facilities of the Hannover Center for Production Technology (PZH) and strengthens the research potential of the PZH in the area of micro production technology.

Physical Electronics Department (SPbPU) had been founded at 1939 for studying of specialist in the physics of devices and electronic techniques systems. At this moment there are 65 members, namely 12 professors, 18 docents. Total number of scientists is 47, including 11 doctors and 16 Candidate of Sciences. Middle age of department member is 48 years. Leading professionals from St.Petersburge institutes and companies, (namely Ioffe Physical Technical Institute, The Institute for Analytical Instrumentation, Military-medical Academy) take a part in educational process.

Research and Education center "Physics of Nanocomposite Materials" (NCM) - is a structural subdivision of Peter the Great St. Petersburg Polytechnic University, created in 2005 on the bases of research and education laboratory "Physics of nanocomposite materials of electronics" is a joint project of physical electronics department of Radio Physical Faculty SPbPU, Ioffe Physic-Technical Institute of Russian academy of Science and Petersburg Nuclear Physics Institute of Russian academy of Science. Major objective of NCM is the investigation and development of new nanocomposite materials for electronic industry and specialist training capable of creating such materials and technologies single-handedly. Among the objective of laboratory was holding graduate students in sciences and research sector. NCM is a joint project of largest scientific and educational centers of region, which gives an opportunity for new coming students, PhD students and young members to participate in "Tomorrow's objectives".

Major scientific directions of NCM are creation and investigation of:

•self-organized nanostructured materials for electronics. Primary samples are perovskite like compounds with low valance substitution, where systems of chemically ordered polar states forms. In such systems due to polar formation it is possible to accomplish effective electromechanical transformation of energy of the order high then homogeneous materials. In our laboratory complex investigation of such structures are done with the use of AFM microscopy and neutron and synchrotron scattering techniques.

•Artificial nanocomposite structure on the bases of dielectric matrixes. In this case the technique of large volume nanostrucutred material creation with controlled spatial characteristics is used. Extra emphasis is on ferroelectric and magnetic nanocomposite materials. Conducted research of such materials allowed to approach a number of application tasks. This was how super paramagnetic limit was met, which could lead to creation of new generation magnetic memory. Analysis of order-disorder ferroelectrics behavior in limited geometry conditions allowed to create highly effective nanocomposote material for small size capacitors.

WHAT WE OFFER / PROJECT DESCRIPTION

NiFe and CoFe alloys are well established as soft magnetic materials for the use in microsystems technology (MST). In addition to these materials, there are materials featuring superior soft magnetic characteristics. Nanocrystalline materials are part of this group of materials. These are characterized by a low coercivity, which can be ascribed to the nanocrystalline properties. Nanocrystalline materials are so far available only as bulk material. Therefore, a technology development for the integration in microsystems is required. An example of a nanocrystalline material is FINEMET®, which is not used in microsystems so far. The thin film processes and the material characterization is in the focus of this project.

The principle goal of this project is to overcome the limitations of the existing soft magnetic materials deposited by sputtering techniques or electroplating. The suggested approach is the use of nanocrystalline alloys. In the proposed project, the following tasks will be addressed:

- Investigation of a deposition process for nanocrystalline thin-films,
- Characterization of the thin-films related to the magnetic, electrical and mechanical properties,
- Development of a model to describe the dependency of thematerial structure on the processing,
- Investigation of thin-film insulation multi-layers.

The project can be separated in two phases. In the first phase, basic investigations on the deposition and characterization of nanocrystalline soft magnetic thin-film layers will be carried out. The task of the IMPT in Hannover, Germany, is the layer deposition and magnetic and mechanical characterization, while the SPBSTU in St. Petersburg, Russia, focuses on the characterization of the deposited layers: The principle process development will be carried out by the IMPT possessing the necessary equipment for the deposition. The SPBSTU is responsible for the inspection of the crystalline structure depending on the process parameters on the magnetic and electrical properties of the films.

In the second project phase, thin-film insulation layers featuring a multilayer design will be developed. These multilayer films are the basis for the fabrication of a demonstrator component to show the benefit of the developed thin films compared conventional soft-magnetic alloys.

KEYWORDS

Nano crystallite soft magnetic materials, inductive micro components, magnetic measurement

COLLABORATIONS SOUGHT

Companies which are interested in high efficient magnetic components