BASE ELEMENTS FOR SUPERCONDUCTING ARTIFICIAL NEURAL NETWORK

Anatolie Sidorenko, Vladimir Boian, Maria Lupu, Andrei Prepelitsa
Technical University of Moldova, Institute of Electronic Engineering and Nanotechnologies, Academiei str., 3/3, Chisinau, Moldova

Energy efficiency and the radically reduction of the power consumption level becomes a crucial parameter constraining the advance of supercomputers. The most promising solution is design and development of the non-von Neumann architectures, first of all – the Artificial Neural Networks (ANN) based on superconducting elements. Superconducting ANN needs elaboration of two main elements – nonlinear switch (neuron) [1] and linear connecting element (synapse) [2]. We present results of our design and investigation of superconducting spin-valves and superconducting synapse, based on layered hybrid structures superconductor-ferromagnet. Results of our theoretical and experimental study of the proximity effect in a stack-like superconductor/ferromagnet (S/F) superlattice with Co- ferromagnetic layers of different thicknesses and coercive fields, and Nb-superconducting layers of constant thickness equal to coherence length of niobium, are presented. The superlattices Nb/Co demonstrate change of the superconducting order parameter in thin s-films due to switching from the parallel to the antiparallel alignment of neighboring F-layers. We argue that such superlattices can be used as tunable kinetic inductors for ANN synapses design. The study was supported by the Project «Nanostructures and advanced materials for implementation in spintronics, thermoelectricity and optoelectronics» no. 020201.

References

1. N. Klenov, Y. Khaydukov, S. Bakurskiy, R. Morari, I. Soloviev, V. Boian, T. Keller, M. Kupriyanov, A. Sidorenko, B. Keimer, Periodic Co/Nb pseudo spin valve for cryogenic memory, Beilstein J. Nanotechnol. 10 (2019) 833–839. https://doi.org/10.3762/bjnano.10.83.

2. S.Bakurskiy, M.Kupriyanov, N.Klenov, I.Soloviev, A.Schegolev, R.Morari, Yu.Khaydukov, A.Sidorenko. Controlling the proximity effect in a Co/Nb multilayer: the properties of electronic transport. *Beilstein J. Nanotechnol.* 2020, **11**, 1336–1345. https://doi.org/10.3762/bjnano.11.118

Corresponding author: Prof. Dr. Anatolie Sidorenko
UTM, Institute of Electronic Engineering and Nanotechnologies "D.GHITU" Academiei 3/3, Chisinau MD2028 Moldova
e-mail: sidorenko.anatoli @gmail.com
ORCID: 0000-0001-7433-4140