# SUPERCONDUCTING NANOSTRUCTURES FOR SPINTRONICS

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Increasing energy consumption and the necessity of the 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 computers with brain-like architecture, first of all – the Artificial Neural Networks (ANN) based on superconducting elements. Superconducting ANN needs elaboration of two main elements – functional nanostrtuctures: nonlinear switch similar to the neuron, and linear connecting elements similar to synapse [1]. There are presented results of design and investigation of artificial neurons, based on superconducting spin valves, and superconducting synapses, based on layered hybrid nanostructures superconductor-ferromagnet. Are presented results of the theoretical and experimental study of the proximity effect in a stack-like superconductor/ferromagnet (S/F) superlattices with Co-ferromagnetic layers of different thicknesses and coercive fields, and Nb-superconducting layers of constant thickness equal to coherence length of niobium.

The superlattices Nb/Co demonstrate change of the superconducting order parameter in thin niobium films due to switching from the parallel to the antiparallel alignment of neighboring ferromagnetic layers. We argue that such superlattices can be used as suitable base elements for superconducting spintronics for ANN engineering [2]. Design of the ANN using that two base elements, artificial neurons and artificial synapses, allows construction of the computer with several orders of magnitude lower energy consumption in comparison with the traditional computer designed from semiconducting base elements.

**ACKNOWLEDGEMENTS:** The study was supported by the project of the Moldova State Program «Functional nanostructures and nanomaterials for industry and agriculture» no. 20.80009.5007.11.

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[2] A. Sidorenko (Editor). Functional Nanostructures and Metamaterials for Superconducting Spintronics. Springer, 2018