SUPERCONDUCTING ARTIFICIAL NEURAL NETWORKS

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The need of radical reduction of energy consumption is becoming a decisive parameter limiting the development of new supercomputers. Recently it was started a very rapidly development of novel research direction: design of non-von Neumann computers with a brain-like architecture or artificial neural networks - superconducting ANNs. That requires the development of base elements of neural network - a nonlinear switching neurons and linear elements synapses, changing connection strength or "weight" of neurons in ANN [1].

The results of the design and research of artificial superconducting ANNs, based on superconducting spin valves and superconducting synapses constructed from layered superconductor-ferromagnetic hybrid nanostructures are presented.

Layered Nb/Co heterostructures demonstrate a change of the superconducting order parameter in thin niobium films due to switch from parallel to antiparallel magnetic ordering of adjacent ferromagnetic layers. Such heterostructures can be used as a base elements of superconducting ANN [2,3]. Computer designed on superconducting ANN using these two basic elements - artificial neurons and artificial synapses, makes it possible to reduce for several orders of magnitude the power consumption compared to the existing computers built on semiconducting elements.

ACKNOWLEDGMENTS: The research 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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