Poster Presentation

MS106.P09

Structural and electrophysical properties in $LiNbO_3$/CoFeB nanocomposite films

Andrey Emelyanov[1], Vyacheslav Demin[2], Vladimir Rylkov[2], Kristina Nikiruy[2], Pavel Kashkarov[2]
[1]*NBICS Centre, National Research Centre "Kurchatov Institute", Moscow, Russian Federation,* [2]*NBICS Centre, National Research Centre, Moscow, Russian Federation*
E-mail: emelyanov.andrey@mail.ru

Memristive devices are the key contenders for the development of multilevel nonvolatile analog memories and parallel neuromorphic computing architectures [1]. In particular, metal oxide memristors have emerged as promising candidates for hardware implementation of artificial synapses in spiking networks due to their excellent scaling prospects [2]. Memristors with fast switching speed, high endurance and long retention time have been reported in various oxides. Among metal oxides the LiNbO3 based system has emerged as a promising candidate for the functional oxide layer in memristive devices [3]. In the present work we study structural and electrophysical properties of (Co41Fe39B20)x(LiNbO3)100-x nanocomposite (LNO NC) films and their possible application in spiking neuromorphic networks.
The LNO NC films of thickness 3 μm were synthesized by ion-beam sputtering of a composite target, allowing in a single cycle formation of Co41Fe39B20 nanoparticles in the LiNbO3 matrix with oxygen vacancies. The factor x was varied in a range of 5 – 48 at. %. For the film with x ~ 10 at. % resistive switching (RS) effect was observed. RS weakly dependent on the contacts material (Cu, Cr) and the thickness of the LNO NC layer. The number of switching cycles (endurance) exceeds Nmax > 105, and the high-resistance to low-resistance state ratio was Roff/Ron = 65. The obtained value of Nmax is comparable with those got in HfO2-based memristors in which, nevertheless, Roff/Ron ratio is significantly smaller, ~ 6.
Observed RS effect is described by the significant influence of oxygen vacancies on tunneling conductivity of chains of metal nanoclusters, determining the electrical resistance of structures below the percolation threshold. The ability of LNO NC memristive devices to support the spike-time-dependent plasticity was demonstrated. These results give every hope for stable operation of future large neuromorphic networks based on LNO NC memristive devices.
The work was partially supported by the Russian Science Foundation (16-19-10233) and performed on the Resource Center facility (Kurchatov Institute).
[1] A. V. Emelyanov, D. A. Lapkin, V. A. Demin, et al. (2016) AIP Advances 6, 111301
[2] M. Prezioso, F. Merrikh Bayat, B. Hoskins et al. (2016) Sci. Rep. 6, 21331
[3] X. Pan, Y. Shuai, C. Wu et al. (2016) Appl. Phys. Lett. 108, 032904
Keywords: memristor, neuromorphic computing, spike-time-dependent plasticity