S1-P.20

Mimicking Brain Activities: Artificial Synapses and Learning Using GaN Membranes

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We show experimentally that ultrathin GaN membranes, having the thickness of 15 nm and planar dimensions of 12 ×184 μm^2, are acting as memristive devices which are the anologue of brain sysnapses. The memristive behavior origins from the migration of the negatively-charged deep traps, which form in the volume of the membrane during the fabrication process, towards the unoccupied surface states of the suspended membranes.

We demonstrate also that single crystalline GaN nanomembranes arranged in simple networks displays learning mechanisms such as habituation and dishabituation followed by storage of the response to a certain electrical stimulus. We also show the possibility of large scale integration of memristors using 2D materials such as graphene or MoS_2.

M.D , A.D. and D.D acknowledge the financial support ofproject GRAPHENEFERRO grant of Ministry of Re-search and Innovation, CNCS-UEFISCDI, number PN-III-P4-ID-PCCF-2016-0033.