Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

The memristive magnetic tunnel junction as a nanoscopic synapse-neuron system[1] ANDY THOMAS, PATRYK KRZYSTECZKO, JANA MÜNCHENBERGER, GÜNTER REISS, MARKUS SCHÄFERS, Physics department, Bielefeld University — Memristors cover a gap in the capabilities of basic electronic components by remembering the history of the applied electric potentials, and are considered to bring neuromorphic computers closer by imitating the performance of synapses. We used memristive magnetic tunnel junctions based on MgO to demonstrate that the synaptic functionality is complemented by neuron-like behavior in these nanoscopic devices. The synaptic functionality originates in a resistance change caused by a voltage-driven oxygen vacancy motion within the MgO layer. The additional functionality provided by magnetic electrodes enabled a current-driven resistance modulation due to spin-transfer torque. We report on memristive magnetic tunnel junctions characterized by the simultaneous occurrence of resistive switching and tunnel magnetoresistance. Since resistivity provides a natural measure of the synaptic strength, and because of the bipolar nature of the resistance change, long term potentiation and long term depression were emulated. Furthermore, we show that the flux is a good variable for describing voltage-induced resistance variation, which provides the scope for the emulation of spike timing dependend plasticity as well.

[1]This work was supported by the MIWF of the NRW state government.

Andy Thomas
Physics department, Bielefeld University

Date submitted: 07 Dec 2011 Electronic form version 1.4