

# “Step-induced defects in thin films and the effect on their electrical and magnetic properties”

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## Abstract

Many transition metal oxides show the electrical induced resistive switching effect and therefore have been proposed as the basis for future non-volatile memories. Non-volatile memories combine the advantages of Flash and (DRAM) while avoiding their typical disadvantages. The resistive switching effect is a change in the resistance of the material between a high and low resistance state upon application of an electric field. In resistive switching the forming voltage is a crucial effect wherein the resistance of an insulator changes dramatically from an initial state to an activated state. The structure itself is simple; consisting of an oxide material located between two metal electrodes in either a planar or sandwich structure. We are working on a planar type structure where we have used stepped instead of flat surface because the presence of step arrays of steps influences the magnetic, electronic and transport properties. It is believed that these stepped surfaces play an important role in the electric field breakdown, which can be crucial in reducing the switching voltage, improving the longevity of memory devices. As a stepped surface substrate, vicinal MgO and SrTiO<sub>3</sub> substrates with different miscut angle have been characterized after annealing at high temperature. It was shown that the stepped surfaces of MgO and SrTiO<sub>3</sub> can be obtained with different periodicity lengths by changing external parameters, like temperature and time. This can be used to control the step density allowing for the study of the electric field breakdown. Such a method offers great control over the step width of the different substrates. One of the oxide materials is Fe<sub>3</sub>O<sub>4</sub> which exhibits the resistive switching phenomena as a result of the change between high and low resistance below the Verwey transition. The thin film of Fe<sub>3</sub>O<sub>4</sub> has been grown epitaxially on stepped surfaces using e-beam technique in Molecular beam epitaxial (MBE) system. All electric measurements have been performed in the closed cycle refrigerator (CCR)