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Thermal magnetic relaxation in sub-100nm square artificial spin ice systems measured by SQUID magnetometry JOSE MARIA PORRO AZPIAZU, Rutherford Appleton Laboratory, STFC, UK, SOPHIE MORLEY, CHRISTOPHER MARROWS, School of Physics and Astronomy, University of Leeds, UK, SEAN LANGRIDGE, Rutherford Appleton Laboratory, STFC, UK —
Artificial spin-ice systems (ASI) are lithographically defined patterns of ensembles of interacting ferromagnetic nanomagnets with bistable single-domain behaviour of the magnetization, arranged in geometries that mimic the magnetic frustration present in spin-ice materials. In the square ASI, each vertex has four nanomagnets whose magnetic moment points either in or out. The lowest energy arrangement consists of two-in and two-out, obeying the ice-rule. We studied the magnetic relaxation of thermally active square ASIs made of Permalloy (NiFe), formed by nanomagnets with dimensions 70x22x6nm3 covering 2mm2, by SQUID magnetometry. We have investigated the effect of the interaction strength, by varying the lattice spacings; and of the oxidation of the Permalloy. We observed that for higher interaction strength the relaxation times decrease to lower temperatures, and that the oxidation does not affect the dynamics other than decreasing the interaction strength due to a reduction of the volume of the nanomagnets. This gives us a way to quantify the effective lowering of the reversal barrier of the individual islands due to the field it experiences from its neighbours. This is compared to the interaction energy as calculated from a simple dipole model and micromagnetic simulations.

Jose Maria Porro Azpiazu
Rutherford Appleton Laboratory, STFC, UK

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