Fabrication of CuMnAs Microdevices for Imaging Current-Induced Switching of Single Antiferromagnetic Domains

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Antiferromagnets attract much attention due to potential applications in spintronics. It was theoretically predicted that it is possible to manipulate the direction of the Néel vector of an antiferromagnet with local inversion asymmetry using a current-induced staggered effective field [1]. The effect was experimentally demonstrated for the collinear antiferromagnet CuMnAs [2]. Photoemission electron microscopy (PEEM) with magnetic contrast arising from x-ray magnetic linear dichroism (XMLD), combined with anisotropic magnetoresistance (AMR) measurements, allowed to image changes in the domain structure revealing that it is systematically modified by subsequent current pulses [3]. However, the nature of the switching process is complex and spatially inhomogeneous in multi-domain antiferromagnetic thin films.

Here, we report on the microfabrication of CuMnAs devices for combined PEEM-XMLD and AMR experiments aiming towards electrical switching of a single antiferromagnetic domain. The application of a lithography process not exceeding 70°C [4], proved necessary for the protection of microdevices (Fig. 1). Measurements of AMR reveal one-directional and irreversible changes in the magnitude of AMR signals (Fig. 2) under subsequent trains of current pulses in temperatures 100K and lower. We are now examining the relation of our findings to magnetic anisotropy specific to this material.

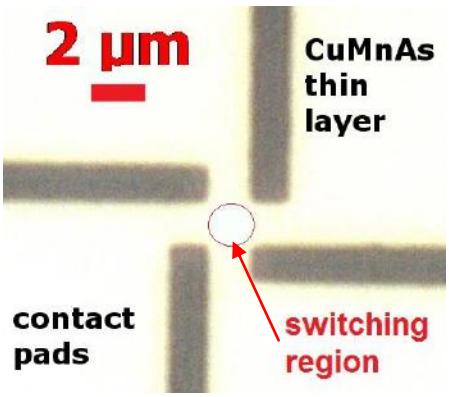

Fig. 1. An example of a CuMnAs device defined by separation trenches (dark regions) etched down to the substrate.

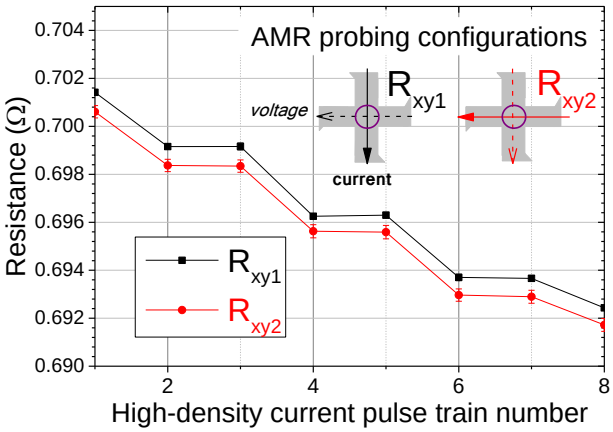

Fig. 2. AMR signals indicating one-directional switching of antiferromagnet by high-density current pulses.

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