Magnetic textures in bulk and thin film Cr_2O_3

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The spin degree of freedom in magnetically ordered materials is an important aspect for a variety of research directions. Antiferromagnets represent a broad class of systems with compensated or almost compensated net magnetization. On one side, it is a factor in the complications of their experimental investigation. However, on the other side, they offer unique features on ultrafast dynamics, strong robustness regarding external magnetic fields and delicate symmetry-driven phenomena in spin torques and multiferroicity. Specific research attention is paid to the properties of antiferromagnetic solitons as potential information carriers and the surface properties at which the readout of the magnetic state is performed. Here, we focus on the seminal magnetoelectric antiferromagnet Cr_2O_3 (chromia) with the easy-axis magnetic anisotropy.

In bulk single crystal chromia, the multidomain state is not favorable due to thermodynamic reasons, thus the stabilization of domain walls is possible on the defects. In particular, the litographically partterned surface topography of the sample can serve as the pinning landscape for the domain wall. The spatial inhomogeneity of this landscape allows to uncover the mechanical properties of the magnetic textures such as elastic deformation of the domain wall plane governed by the exchange boundary conditions [1]. In contrast, the chromia thin films are commonly in the multidomain state, which is determined by their granular structure. The domain wall pinning at the defects depends on the defect properties. Therefore, the visual analysis of the domain picture obtained, e.g., via Nitrogen vacancy magnetometry can be used as a source of quantification of the inter-grain coupling in the thin film [2]. Furthermore, in the case of the high-quality chromia samples epitaxially grown at sapphire substrate, the presence of domain walls allows to reveal a new temperature-driven source of the flexomagnetism in thin antiferromagnetic films [3].

Even in absence of specific processing like litography or design of exchange bias multilayers, the surface of an antiferromagnet can alter its magnetic state by its specific magnetic symmetry. Chromia possesses two nominally compensated high-symmetry planes with an experimental evidence of finite magnetization. It can be understood by the surface magnetic point symmetry group, which renders the *m* and *a* planes of chromia to be canted ferrimagnet and antiferromagnet, respectively [4].

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