ROLE OF MAGNETIC SURFACE ANISOTROPY IN MAGNONIC CRYSTAL

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Magnonics is a rapidly developing field of science and technology. Using spin waves as information carriers allows operations in the GHz frequency range while keeping the size of the device in the nanometer range [1]. To tailor the spin wave propagation according to our needs, we can use various approaches. One possibility is the patterning of magnetic material, e.g. by forming so-called magnonic crystals, which are periodic magnetic nanostructures. However, changing the geometry or material composition may not be sufficient, so other factors are being sought to tailor the properties of the spin wave. One possibility inherent in the geometry is to change the boundary conditions, which were described by Rado and Weertmann [2] and later developed by K. Yu. Guslienko [3,4]. The boundary conditions were refined using the spin wave pinning parameter, which describes the contribution of shape and surface anisotropy. Due to the complexity of the issue, the effect of the spin wave pinning and the possible applications are still under consideration.

In my research, I focused on the role of surface anisotropy in the case of a planar two-dimensional magnonic crystal. The investigated system consists of square CoFeB dots, separated by a non-magnetic spacer. The surface anisotropy at the lateral edges of the dots modifies the spin wave pinning and thus dynamic surface magnetic charges. As a result, the spin wave profiles (inside magnetic dots) and the distribution of dynamic stray fields (in the spacer between them) are changing. These effects influence magnetization dynamics inside the dots and the dynamic coupling provided by the stray field which is reflected in the modification of the collective spin wave modes in the array of dots.

We considered co-called forward geometry, where the static magnetization is oriented out-of-plane. The implementation of surface anisotropy on selected edges of dots can break the four-fold symmetry of the structures and introduce the difference in spin wave propagation in two principal directions of the square lattice.

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