Coexistence of multiple magnetic domain subsystems in van der Waals magnet $CrBr_3$

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Magnetic behaviour of two-dimensional magnets can be significantly different from their 3D forms. For instance, recently it was demonstrated that thin crystals of chromium trihalides can possess different magnetic properties depending on the number of layers [1,2] and the stacking order, which can change ferromagnetic coupling to antiferromagnetic one [2,3,4,5]. In this work, we use cryogenic magnetic force microscopy (MFM) and magneto-photoluminescence measurements to investigate $CrBr_3$ crystals with intermediate thicknesses and discover that several types of magnetic order can coexist within the same crystal, resulting in a peculiar overlay of different domain patterns in the MFM signal. With the help of micromagnetic simulations and image analysis, we proposed a new phase diagram based on the correlation between two domain patterns. This diagram reveals that the presence of a stacking fault with antiferromagnetic coupling and weak interlayer coupling is essential for the formation of different domain groups in the same sample.

References

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Figures

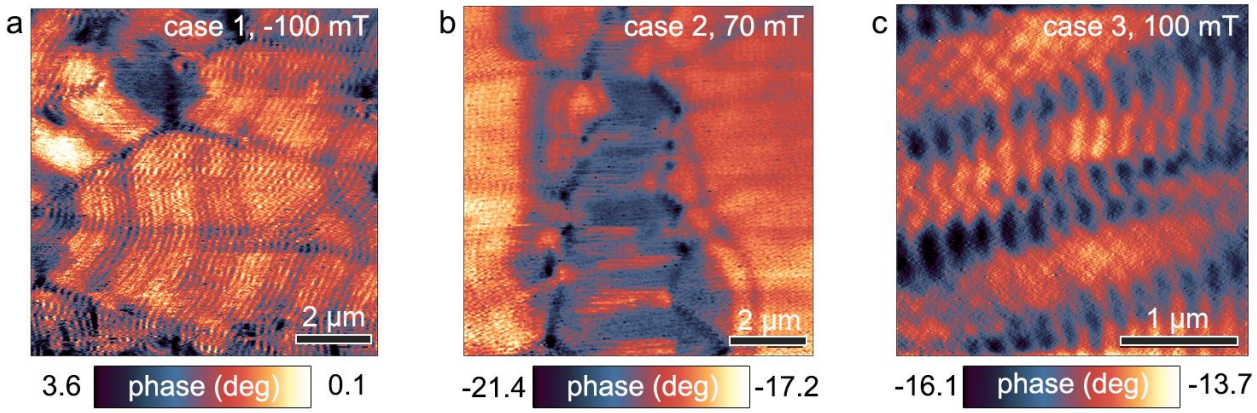

Figure 1: Coexistence for several domain subsystems for van der Waals $CrBr_3$ crystals. a-d – Magnetic force microscopy images at different magnetic fields of 190 nm thick sample. On the MFM images, there are at least three (a,b) or two (c) coexisting patterns of different intensities and sizes.