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Antiferromagnetic domains nucleation and growth dynamics studied by magnetostriction of the TbB_6

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The antiferromagnetic (AFM) ground state of cubic TbB_6 is characterized by multiaxial ordering and a complex magnetic phase diagram. Magnetic susceptibility and magnetostriction show a tetragonal symmetry of AFM phase [1]. The x-ray diffraction shows the charge reflections resulting from the formation of static atomic displacement waves which can be described as a compromise between the exchange and a single-ion elastic couplings [2].

The single crystal of TbB_6 is studied at the first order AFM phase transition and within the ordered phase by means of magnetostriction and anisotropic magnetic susceptibility in magnetic fields up to 6 T. The tetragonal AFM phase below $T_N = 21$ K is a mixture of three equivalent AFM domains. Based on the symmetry of spontaneous deformation and the magnetostriction data we conclude that Tb magnetic moments lay in the tetragonal plane. If we apply magnetic field of about 5 T along one of the fourfold axes, the energetically most favorable domain is selected, and the whole crystal tunes into a single-domain state. This state is stable even in zero magnetic field. The observed behaviors are consistent with the tetragonal symmetry of the AFM state.

In this work we discuss the the domain selection line observed in the magnetic phase diagram. We relate this line to the measured anisotropic magnetic susceptibilities and the magnetic energy difference for the magnetic field applied along the two characteristic directions of AFM domain. For a sudden change of the field direction to another fourfold axis the nucleation and the growth of another domain emerge. We attain to explain the temperature and field dependent time evolution of this process. We use the time dependence of magnetostriction to study the domain nucleation and growth dynamics.

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