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Real Space Observation of Helical Spin Order by Lorentz Microscopy MASAYA UCHIDA, ERATO, Japan Science and Technology Agency (JST), Tsukuba, Japan, YOSHINORI ONOSE, ERATO-JST, Tsukuba, Japan, YOSHIO MATSUI, AML, National Institute for Materials Science (NIMS), Tsukuba, Japan, YOSHINORI TOKURA, Univ. Tokyo, Tokyo, Japan — Helical spin order is widely observed and its average structure has been investigated so far in reciprocal space mainly by neutron diffraction. Here the helical spin order and dynamics are visualized in real space by means of Lorentz electron microscopy. Our system of choice is $Fe_{1-x}Co_xSi$, which exhibits a helical spin order with a long period (> 30 nm) in a concentration range $0.05 \leq x \leq 0.8$. The Néel temperature T_N and the helix period for $x = 0.5$ take about 38 K and 90 nm along the [100] direction, respectively. The helical spin order is due to the Dzyalosinsky-Moriya (DM) interaction because of the lack of centrosymmetry of the lattice. The observations were made by means of a Lorentz transmission electron microscope operated at 300 kV. The magnetization distribution was obtained by the transport of intensity equation (TIE) analysis. The real world of the helical spin order proves to be much richer than expected from the averaged structure, as manifested by variegated magnetic defects like atomic boundary and dislocation in the crystal lattice. By applying magnetic fields we can directly observe the deformation processes of the helical spin order, accompanied by nucleation, movement, and annihilation of the magnetic defects.

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