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Conical spin-spiral ground state of a Mn double layer on W(110) driven by higher-order exchange interactions YASUO YOSHIDA, University of Hamburg / The University of Tokyo, SILKE SCHROEDER, PAOLO FERRIANI, University of Kiel, DAVID SERRATE, Universidad de Zaragoza, KIRSTEN VON BERGMANN, ANDRE KUBETZKA, University of Hamburg, STEFAN HEINZE, University of Kiel, ROLAND WIESENDANGER, University of Hamburg — The magnetic properties of transition-metal nanostructures are commonly explained based on the interplay of Heisenberg exchange, Dzyaloshinskii-Moriya (DM) interaction and magnetocrystalline anisotropy while higher order terms such as the biquadratic exchange and the four-spin interaction are typically neglected due to their small strength. Here, we demonstrate that higher-order terms can play a crucial role for the magnetic ground state and report as an example a transverse conical spin-spiral state in an ultra-thin film composed of two atomic layers of Mn on W(110). This spin structure is characterized by magnetic moments rotating on a cone that is perpendicular to the [001] propagation direction of the spin-spiral with a periodicity of 2.4 nm. The cones of nearest-neighbor Mn atoms point into opposite directions which results in nearly antiferromagnetic alignment. This intriguing spin structure has been resolved on the atomic-scale using spin-polarized scanning tunneling microscopy and confirmed to be the ground state by first-principles calculations based on DFT. Our calculations also reveal that the canting of the spins is induced by higher-order exchange interactions while the spiraling along the [001]-direction is due to frustrated Heisenberg exchange and DM interaction.

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