Nanoscale visualization of symmetry-breaking electronic orders and magnetic anisotropy in a kagome magnet YMn_6Sn_6

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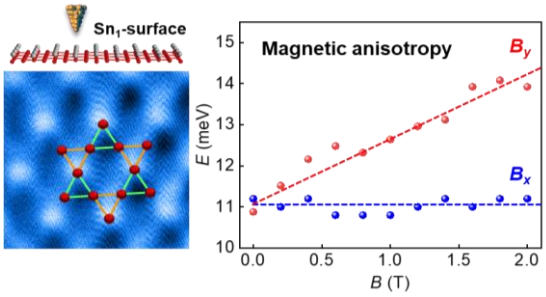
Kagome lattice hosts a plethora of quantum states arising from the interplay between nontrivial topology and electron correlations. The recently discovered kagome magnet RMn_6Sn_6 (R represents a rare-earth element) is believed to showcase a typical kagome band, with Dirac cones, flat bands, and Van Hove singularities located near the Fermi level. The Mn-Kagome layers dominate the nontrivial topological electronic properties of the crystal, while the R element significantly influences the magnetic structure. Therefore, the RMn_6Sn_6 family possesses numerous novel and tunable quantum properties[1]. YMn_6Sn_6, as one of its members, exhibits a spiral antiferromagnetic structure along the c-axis at low temperatures due to the non-magnetic Y[2]. Investigating the kagome lattice electronic states and magnetization responses is crucial for understanding the unconventional electronic behaviors and complex magnetic phenomena arising from its unique geometric structure.

Here, we report the characterization of local electronic states and their magnetization response in YMn_6Sn_6 via scanning tunneling microscopy measurements under vector magnetic fields[3]. Our spectroscopic maps reveal a spontaneously trimerized kagome electronic order in YMn_6Sn_6, where the sixfold rotational symmetry is disrupted while translational symmetry is maintained, exhibiting correlation-driven unusual orbital textures. Further application of an external vector magnetic field demonstrates a strong coupling of the YMn_6Sn_6 kagome band to the field, which exhibits an energy shift discrepancy under different field directions, implying the existence of a magnetization-response anisotropy and anomalous g factors. Our findings establish YMn_6Sn_6 as an ideal platform for investigating kagome-derived orbital magnetic moment and correlated magnetic topological states.



Pic. 1 There exists a spontaneously trimerized kagome electronic order in YMn_6Sn_6, and it exhibits anisotropic magnetic responses when external vector magnetic fields are applied in different directions.

Bibliography

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[3] Jia, L.#; Chen, Y.#; Zhang, Y#. *et al. Nano lett.* **2024**, **24**: 8843.