Lattice and electronic structure study of $A(Fe,Ni)_6Ge_6$ Kagome materials with translational and rotational symmetry breaking

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Kagome materials have gathered significant attention for their diverse quantum phases driven by the interplay between lattice, orbital, and spin orders. Recently, a new family of $A(Fe,Ni)_6Ge_6$ Kagome materials was synthesized, featuring a crystal structure based on the correlated Kagome antiferromagnet FeGe with charge density wave (CDW). Theoretical studies predict instabilities in these materials that could lead to translational and rotational symmetry-breaking orders, though experimental investigations remain absent.

Here, we present lattice and electronic structure studies on $A(Fe,Ni)_6Ge_6$ compounds using diffuse scattering and angle-resolved photoemission spectroscopy (ARPES). The characteristic electronic structures of Kagome materials, such as Dirac cones (DCs), van Hove singularities (vHSs), and flat bands (FBs) near the Fermi level are confirmed via ARPES. Interestingly, diffuse scattering maps revealed evidence of translational and rotational symmetry breaking, including additional superlattice peaks and broad Bragg peaks. Our work will pave new avenues for exploring the rich properties of $A(Fe,Ni)_6Ge_6$ Kagome materials with FB, vHS, magnetism, CDW, nematicity, and their intriguing interactions.