Exploring element specific spin reorientation and magnetic tuning in Antiperovskite Nitrides

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Antiperovskite nitrides Mn_3AN (A = transition metal) provide a unique platform for studying noncollinear antiferromagnetism, strong spin–orbit coupling effects, and tunable anomalous Hall responses emerging from geometrical frustration in the cubic lattice. Here we propose to investigate thickness-dependent magnetism in Mn_3NiN thin films and strain-induced magnetic reconstruction in $Mn_3Cu_{0.65}Ni_{0.35}N$ using element-specific X-ray magnetic circular dichroism (XMCD) and X-ray magnetic linear dichroism (XMLD) at the Mn, Cu, and Ni $L_{2,3}$ edges. By systematically reducing film thickness, we aim to determine whether confinement modifies the noncollinear spin arrangement, induces spin canting, or enhances weak ferromagnetic components. Complementarily, we have explored epitaxial strain in $Mn_3Cu_{0.65}Ni_{0.35}N$ to tune exchange frustration and magnetocrystalline anisotropy, allowing us to probe strain-driven spin reorientation transitions. Temperature- and angle-dependent XMCD measurements quantify the element-resolved spin and orbital moments, while XMLD directly probes antiferromagnetic axis reorientation and magnetic anisotropy. The combined study establishes how dimensional confinement, chemical and strain engineering control the balance between competing magnetic interactions in antiperovskite nitrides which will offer pathways for engineering strain- and thickness-controlled spin functionalities for antiferromagnetic spintronic applications.