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Beyond the Surface: 3D Probing of Antiferromagnets —A Journey Through Failures and Breakthroughs

Tuesday, 7 October 2025 09:00 (35 minutes)

Three dimensional magnetic systems hold the promise to provide new functionality associated with greater degrees of freedom. Over the last years we have worked towards developing methods to fabricate and characterize three dimensional magnetic structures. Specifically, we have combined X-ray magnetic imaging via circular dichroism (XMCD) with new iterative reconstruction algorithms to achieve X-ray (ferro)magnetic tomography and laminography in 3D volumes with sub 100 nm spatial resolution [1-4]. Recent revival of interest on antiferromagnets have driven our recent efforts in developing an approach to image the antiferromagneticorder parameter in micron-size sample with nm spatial resolution.

To this end, we have attempted to use coherent magnetic diffraction and antiferromagnetic tomographic imaging via X-ray linear dichroism. Over the course of several experimental campaigns, we have advanced these approaches and ultimately developed X-ray Linear Dichroic Orientation Tomography (XL-DOT) —a novel, quantitative, and non-invasive technique for three-dimensional characterization of extended polycrystalline and non-crystalline materials at the intra- and intergranular levels [5-6].

The figure included here shows a reconstructed grain structure along with the local crystallographic c-axis alignment. The spectroscopic and non-destructive nature of XL-DOT makes it ideally suited for operando investigations, enabling simultaneous chemical and microstructural analysis of functional materials, including antiferromagnets.

REFERENCES

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