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Investigating Nanoscale Structure via Coherent Resonant X-Ray Scattering

Correlated materials such as transition-metal oxides exhibit nanoscale structures resulting from e.g. magnetic, orbital or charge order. While resonant scattering of soft x-rays in transmission geometry provides unique sensitivity to such ordering and can also enable high resolution imaging, most samples have to be grown epitaxially on single crystalline substrates and are not penetrable by soft x-rays in this configuration.
In this contribution we report on different approaches to make such standard samples suitable for transmission imaging experiments, having in particular resonant x-ray holography in mind. The goal is to thin the substrate to a few hundreds of nanometers over a sufficiently large transverse region. We focus on thin films of magnetite (Fe3O4) on MgO (100) as a prototypical sample system of interest. Two different thinning approaches are investigated: Mechanical thinning similar to TEM sample preparation as well as etching. Given that the transmission depends exponentially on the thickness and that we want to achieve "imaging quality" with respect to lateral thickness variations, we characterize the resulting substrate profiles using different microscopies. Furthermore, first soft x-ray SAXS results on MBE-grown magnetite films prepared in this way are presented.

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