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Neutron diffraction competing with high resolution X-ray diffraction: Any chances?

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Structural investigations on functional ceramics is an important tool for material characterisation and tailoring of properties for specialised applications. This frequently requires high angular resolu-tion to resolve highly correlated phase coexistences or subtle structural features. The most common tool is high resolution X-ray or synchrotron radiation. Especially for in situ investigations in transmission geometry, synchrotron facilities are the usual choice. In special cases even optimised setups with 2D detectors are not able to resolve weak reflection splitting of phase coexistences. Then analyser detectors with a resolution at the physical limit are necessary. However, with increasing brilliance and decreasing beam sizes at the synchrotron sources, the grain statistics become a significant challenge and in some cases the feasible experiments are limited to microstructures with grain sizes in the low µm range.
Since many material systems exhibit grain sizes well above this limit, other characterisation methods are necessary. Here the unique properties of neutron instruments can be exploited. Due to the usually rather high wavelengths, the minimum in the curve of reflection widths lies at relatively high angles. Together with the high reflection intensities at high diffraction angles, these setups can be a real competitor for synchrotron instruments. We will demonstrate this with two examples in the material systems potassium sodium niobate and barium titanate.

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