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Chemical composition of nano-phases studied by anomalous small-angle X-ray scattering (ASAXS)

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Anomalous small-angle X-ray scattering (ASAXS) is a technique developed in the 1980s. It offers the opportunity to go further in the investigation of nano-objects by providing chemical information besides characteristic features like size and volume fraction given by classical SAXS. ASAXS is an element-selective technique based on the anomalous variation of the scattering factor near the absorption edge of one chosen element. This technique requires a tunable wavelength of the incident beam that is available on synchrotron radiation sources.

In this study, a simple approach is proposed and detailed to extract chemical information from anomalous SAXS data. To illustrate the procedure, two examples are treated by applying this data processing. The first one aims to discriminate between different possible phases in the Y-Ti-O system that may form nano-oxides in oxide-dispersion-strenghtened (ODS) steels, materials for future nuclear plants. The second one deals with the composition of nano-precipitates formed in the diffusion layer of nitrided steels. Such information is of prime importance to evaluate the maximum nitrogen that can be introduced by such a surface treatment and thus the mechanical properties that can be achieved.