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Diffraction Based Determination of Single Crystalline Elastic Constants on Polycrystalline Alloys

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The tensor components of the stiffness tensor, also known as elastic constants, are directly related to material parameters such as the shear-, Young's- and Bulk modulus. But also non-mechanical properties such as the Debye temperature can be calculated using the tensor components. Elastic constants are essential for many applications, e. g. the stress analysis by diffraction, where from measured strains residual stresses are determined with use of the elastic constants.
Different diffraction techniques allow the investigation of poly-crystalline and multi-phase materials due to its outstanding possibility to visualize the different strains of all phases averaged over all orientations. Combining this with the knowledge of the occurring stresses enables a type of reversal of the classical stress analysis calculation with elastic constants as result.
The validation of our approach was done on different types of Iron S 235 JR (BCC), V2A (FCC) and Duplex Steel (BCC and FCC) revealing a good agreement between our results and the literature data. Further Investigations were performed on different technically applied Ti-alloys including α-, β- and α+β-Ti. Despite their technical relevance only a few comparable literature data exists. The correctness of the results was then ensured by calculating macroscopic values and comparing them to either literature data and/or own experiments.

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