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Phase analysis of steel using neutron grating interferometry and bragg edge imaging

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Austenitic steel transforms to martensite under applied strain. An undesired modification of the mechanical properties by this process is typically compensated by annealing to restore the austenitic phase. Recently, it has been proposed to introduce a beneficial residual stress state in the material.

A spatially resolved determination of the phase fractions of martensite is required for the quantification of local residual stress introduced by manufacturing [1,2].

We non-destructively tracked the amount of martensite inside drawn austenitic steel samples using neutron bragg edge imaging (BEI) and neutron grating interferometry (nGI).

Differentiation between the two phases is possible by BEI due to their different crystal structure but complicated by strain induced texture.

nGI on the other hand is sensitive to scattering off ferromagnetic domains composed of martensite inside the material [3].

To verify the results of the two techniques we compared them to surface micrographs of the samples.

[1] M. Baumann, A. et al., MATEC web of Conferences 190, 2018

[2] K.A. De, et al., Scripta Materialia 50, pp. 1445-1449, 2004

[3] F. Pfeiffer et al., PRL, 96.21 (2006), 215505

Primary authors: NEUWIRTH, Tobias; GLAS, Cynthia; Mr BÖHM, Lucas (utg); SCHULZ, Michael; BÖNI, Peter (Technische Universität München)

Presenter: NEUWIRTH, Tobias

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