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A tensile rig for neutron imaging

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Electrical steel sheets are used as the magnetic cores of electric engines. Stress in such sheets causes energy loss during the reversal of magnetization due to the magneto-elastic effect, which can be used to guide the magnetic flux. Such change in the magnetic properties can be detected by neutron grating interferometry (nGI), which allows to map ferromagnetic domains in bulk materials [1].

Previously, the effects of residual stress in electrical steel sheets, introduced through embossing, were investigated [2,3].

Now a more realistic case for electric engines is planned to be tested by replicating the effects of alternating magnetic fields and centrifugal forces.

Hence, a custom tensile rig for the nGI setup of the ANTARES beamline was built.

The new tensile rig in combination with a newly constructed magnetic yoke allows to place sheet metal samples in the nGI setup at varying levels of mechanical strain while simultaneously applying static or alternating magnetic fields. Therefore, the effects of overlapping centrifugal tensile strain and residual stress from embossing of electrical steel sheets can be evaluated.

The tensile rig can furthermore be used with different inserts to accommodate arbitrarily shaped samples.

[1] C. Grünzweig et al., APL 93, 112504 (2008)

[2] S. Vogt et al., Production Engineering 13.2 (2019), pp. 211-217

[3] H. A. Weiss et al., Journal of Magnetism and Magnetic Materials 474 (2019), pp. 643-653

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