Karlsruher Institut für Technologie

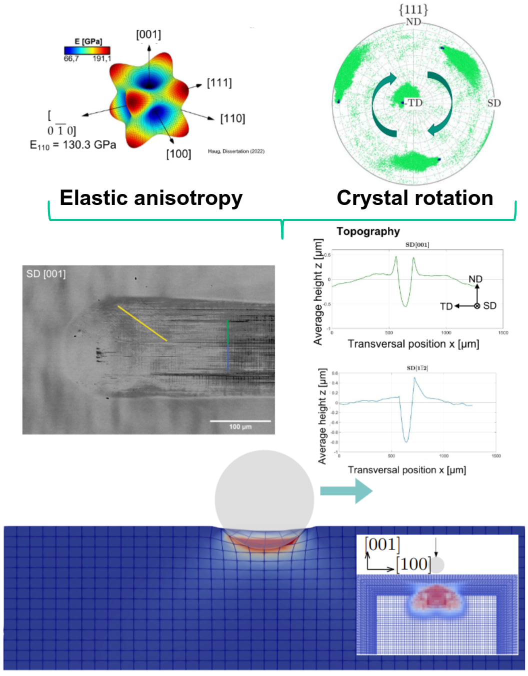
Institut für Angewandte Materialien

# Bachelor-/Master Thesis

## Analysis of Crystal Rotation under Tribological Stress through Mechanism-Based Crystal Plasticity Simulations

### Background:

Brushing teeth, biking, a wind turbine have one thing in common: They have at least two bodies in contact and in relative motion to each other, which are also called tribological contacts. As shown by the examples, these appear everywhere, in our every day life as well as in technical applications. Tribological properties are influenced by e.g. the atmosphere, the materials in contact, but also the microstructural evolution under tribological loading. In all metallic bodies, crystal rotation is the beginning and results with failure by wear particle formation. To investigate this topic, we'll examine how factors such as dislocation dynamics and reactions, crystal orientation, and initial dislocation density and distribution affect dislocation structures under tribological loads. Through meso-scale simulations, we'll explore how dislocations interact and impact mechanical responses and surface topography, as seen in experimental observations. This practical approach will enhance our understanding of material behavior under tribological conditions.




### Goals of the thesis:

The objective of this bachelor's/master's thesis is to explore the dislocation evolution triggered by tribological loads. Using finite element simulations grounded in continuum dislocation dynamics (CDD) theory, this study aims to predict changes in dislocation structure, surface topology, and mechanical responses to tribological stresses across various crystal orientations. The findings will be analyzed and compared with experimental results.

### Requirements :

This study requires an investigation of the dislocation structure under various parameters as outlined in the experiments, using a finite element program developed in C++. Therefore,

- a fundamental understanding and interest in material science and finite element simulation are essential.
- programming knowledge of C++, python are advantages but not mandatory.

### Contact:

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