Technical University of Denmark

# Popular science summary of the PhD thesis

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| PhD student | Felix Tristan Frankus |
| Title of the PhD thesis | Dislocation Dynamics of Patterning |
| PhD school/Department | Department of Civil and Mechanical Engineering |

## Science summary

* Please give a short popular summary in Danish or English (approximately half a page) suited for the publication of the title, main content, results and innovations of the PhD thesis also including prospective utilizations hereof. The summary should be written for the general public interested in science and technology:

The mechanical properties of metals are largely governed by the behaviour of dislocations—line defects in the crystal structure that facilitate plastic deformation. While it is well known that dislocations can self-organize into mesoscopic structures known as patterns, a first-principles model capable of predicting their formation and evolution remains elusive. My PhD research contributes to bridging this gap by combining computational simulations with advanced X-ray microscopy to investigate the fundamental mechanisms underlying dislocation patterning.

Using Discrete Dislocation Dynamics simulations, I explored the self-assembly of dislocations into Geometrically Necessary Boundaries, a key type of dislocation patterning. These simulations revealed the conditions under which planar dislocation boundaries emerge from initially random dislocation configurations. In parallel, I conducted an experimental study using Dark-Field X-ray Microscopy, a synchrotron-based technique that enables three-dimensional imaging of dislocations inside bulk crystals. By applying in-situ deformation to an aluminium single crystal, I captured the real-time evolution of individual dislocations, revealing the formation of a dislocation pile-up.

This study not only demonstrates the potential of Dark-Field X-ray Microscopy for resolving dislocation dynamics but also provides a benchmark dataset for validating computational models. By linking experimental observations with simulation results, my research contributes to the understanding of dislocation self-organization.

Please email the summary to the PhD secretary at the department