Popular science summary of the PhD thesis

PhD student	Elisabeth Filippa Ferdinand Knipschildt-Okkels
Title of the PhD thesis	Critical Effects of Microstructural Heterogeneities in Aluminium Alloys on Nucleation of Recrystallisation
PhD school/Department	DTU Contruct

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. Before the thesis defence, the summary is sent to DTU's Office for Communication and Media and to the media *Ingeniøren*:

Aluminium alloys are used in many different applications in our everyday lives from beer cans to automobile sheet parts. The interest in using aluminium alloying parts is increasing due to their light weight and corrosion resistance.

Most aluminium alloys are thermomechanical processed, meaning that the alloys go through different plastic deformation and heat treatment schedules to obtain the wanted mechanical properties. As the metal is plastically deformed, defects are introduced to accommodate the crystal planes moving relative to each other. During heat treatments recrystallisation can take place, creating a new microstructure. Recrystallisation is initiated by nucleation of very small almost defect-free volumes. On the microscopic scale most metals are heterogenous. Predicting where the nuclei appear in the heterogenous microstructure has been attempted for decades, yet it remains an estimate at best. Nucleation of recrystallisation models are essential when wanting to predict the mechanical properties of the thermomechanical processed metal. Due to experimental limitations, recrystallisation nucleation has mainly been studied in 2D, which might be one of the causes of the limited knowledge about the subject.

In this project nucleation of recrystallisation in aluminium alloys is studied by multimodal 3D and 4D X-ray techniques. The effect of second phase particles on nucleation is studied in an industrially relevant aluminium alloy. It is found that the particles dominate nucleation, as well as dependencies on particles type and size are observed. Residual elastic strain is found in the recrystallized nuclei. The effect of local plastic strain is studied in a commercially pure aluminium alloy. No obvious effect is found, yet all nuclei are found to appear in grain boundary multi junctions and having close orientation relationships to neighbouring grains. It is suggested that nucleation in this alloy is dominated by strain induced boundary migration. This work shows that nucleation is highly dependent on the heterogeneities of the deformed microstructure.

Please email the summary to the PhD secretary at the department