

Popular science summary of the PhD thesis

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Title of the PhD thesis	In-situ Martensite Formation
PhD school/Department	DTU Construct

Science summary

* Please give a short popular summary (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:

Martensite is a vital component in steel that greatly enhances its strength and durability. Typically, martensite forms instantly when steel cools, but it can also form slowly over time at sub-zero temperatures. This time-dependent formation is not well understood.

This PhD research investigated martensite formation in 17-4 PH stainless steel, commonly used in industry and suitable for 3D printing (additive manufacturing). By adding nitrogen to this steel, the study aimed to understand how it affects martensite formation. Using advanced in-situ techniques like magnetometry and dark field X-ray microscopy, the research monitored martensite formation in real-time.

The findings revealed that higher nitrogen levels lower the temperature at which martensite starts to form and change its microstructure from lath-like to plate-like morphology. It was found that both types of martensite can form isothermally above their usual martensite starting temperatures. This study also provided evidence of thermally activated martensite formation requiring incubation time, particularly at very low temperatures.

The research has significant implications for the steel industry, allowing for the tailoring of steel properties through controlled heat treatments to develop stronger, more durable steels for various applications, from construction to aerospace.