Investigation of strain-age cracking in Ni-based superalloys using hi-energy synchrotron radiation

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Strain-age cracking (SAC) is a solid-state phenomenon that manifests as intergranular cracking during post-weld heat treatments or during reheating in multi-pass welds. It is one of the key sources for failure in additive manufacturing and traditionally welded Ni-based precipitate hardening alloys. Despite knowledge of its existence for several decades, the key mechanism(s) for SAC is still under considerable debate.

Over the years, a number of theories have been conjectured trying to explain the key mechanism for SAC. The most prominent of those theories are: contraction of grains during intragranular precipitation; precipitation of intergranular carbides; and grain hardening caused by intragranular precipitates. To increase the understanding of failure in precipitate hardening superalloys, grain hardening caused by intragranular precipitates has been investigated using hi-energy synchrotrons.

The experiment has been performed at the Swedish Materials Science beamline, p21.2 at the Petra III storage ring of the DESY Synchrotron, Hamburg, Germany, where in-situ and combined Synchrotron X-ray microtomography, scattering and diffraction experiments of loaded samples have been performed. The number of pores/cracks has been detected for samples aged at different stages. The preliminary results are intriguing.

Martin Fisk, MAU, will give an introduction to the experimental setup and results from the Small-Angle X-ray Scattering (SAXS) experiments used to measure the precipitate size distributions in the alloy.

Emanuel Larsson, LTH, will introduce the underlying theory of tomographic imaging techniques and image analysis and their potential for evaluating materials science samples.

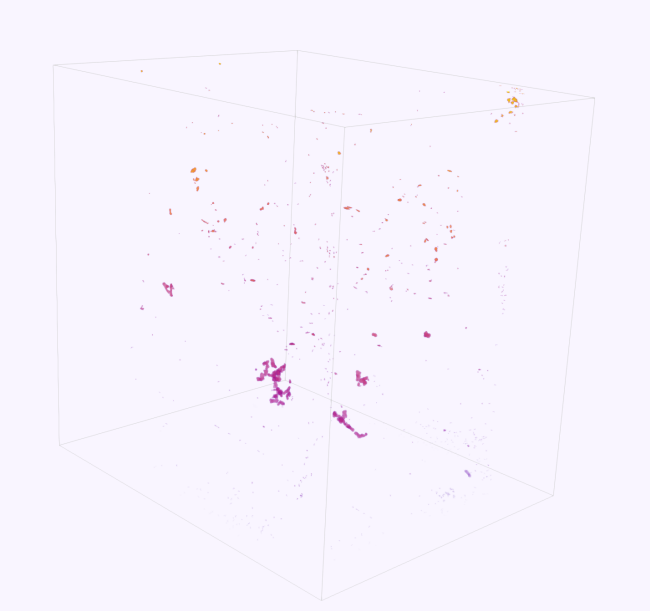

Figure 1: Cracks and pores of a loaded sample detected using tomography