MICRO STRESS ACCUMULATION IN MULTIPHASE SUPERALLOYS

J. Repper[1], M. Hofmann[1], C. Krempaszky[2], W. Petry[1], E. Werner[3]

[1]Forschungsneutronenquelle Heinz Maier-Leibnitz (FRM II), TU München, D-85747 Garching
[2]Christian-Doppler-Laboratory of Material Mechanics of High Performance Alloys, TU München, D-85748 Garching, Germany
[3]Institute for materials science and mechanics of materials, TU München, D-85747 Garching, Germany

The thermal and mechanical properties of high performance alloys are strongly affected by changes in the microstructure due to thermo-mechanical treatments during the production processes. In addition to changes in the microstructure this often goes along with the accumulation of macroscopic (type I) and microscopic (type II) residual stresses. While the effects leading to the evolution of macroscopic stresses are well understood, the exact microscopic mechanisms responsible for the accumulation of microscopic stresses are known only to a lesser extent. However, to understand mechanical behaviour of components made from complex materials like superalloys (e.g. Inconel 718) micro stresses can not be neglected. Micro stresses can be distinguished into two groups: Intergranular micro stresses originate from the elastic and plastic anisotropy of differently oriented grains, whereas interphase micro stresses result from the different micro-mechanical behaviour of different phases.

One method of choice to study the accumulation of micro stresses in dependence of the microstructural properties of matrix and precipitates (grain size, grain shape, volume fraction, type of precipitates, coherency…) are in-situ loading experiments using synchrotron and neutron diffraction. In this contribution we will present the results of a comprehensive diffraction study on Inconel 718 samples possessing different microstructures.