



The ICAMS Seminar presents

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Modelling the mechanical behaviour of single crystal superalloys: An overview

Ni-base single crystal superalloys are widely used as blade materials in the hottest section of gas turbines or aero-engines. For structural analysis and life prediction of the components, a description of the inelastic behaviour of the alloy in a wide temperature range is required. However, despite the number of papers published in this area, the modelling of these alloys still constitutes a challenge for material modellers for several reasons:

- Multiple deformation mechanisms can operate simultaneously and their activation can depend on temperature or stress level.
- The deformation behaviour strongly depends on the crystal orientation.
- Finally the morphology becomes unstable at high temperature and the degraded microstructure behaves differently than the initial one.

Constitutive laws can be formulated at the macroscopic level or at the microstructural level. Macroscopic models are suitable for structural analysis and generally more flexible with regard to the description of versatile deformation mechanisms. Microstructural models contain less free parameters and incorporate more easily the insights resulting from detailed analyses (e.g. TEM) of the deformation mechanisms. In this paper, examples of both approaches are presented. The application of the models to various superalloys (e.g. CMSX-4) in the high temperature regime is demonstrated. The strength and weakness of the presented models as well as still opened questions are discussed.