Karlsruher Institut für Technologie

Laboratory for electron microscopy
Engesserstr. 7
76131 Karlsruhe

Laboratory for Electron Microscopy

Masters Thesis

In-situ heating and tensile straining of the eutectic Mo-Si-Ti alloy in Transmission electron microscope (TEM)

Research area

☐ alloy design
☒ microstructural characterization
☐ Mechanical testing

Focus

☒ Experimental
☐ Failure analysis
☒ Structural characterization
☐ Equipment development
☐ Modeling
☐ Simulation
☒ Literature and research

Course of studies

☐ Electrical engineering and information technology
☒ Materials science
☐ Physics
☐ Chemical engineering
☐ Technomathematics
☐ Industrial engineering

Start

from October

Contact person

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Motivation

Recently Mo-Si-Ti system has been explored as a potential alternative to the existing high temperature materials because of their high melting temperatures. Among them, the eutectic Mo-Si-Ti alloy displayed resistance to pesting oxidation and good creep resistance. The alloy has a typical two phase microstructure with a molybdenum solid solution (Mo_{ss}) and hexagonal $(Ti,Mo)_5Si_3$ silicide phase. The presence of silicide precipitate (in different sizes from 30 nm to 100 nm) in Mo_{ss} interfere with the gliding dislocations in the as-cast microstructure. An enhanced understanding of interfacial deformation and strain partitioning among two phases is necessary during loading. In-situ tensile tests provides better insights into the deformation mechanisms rather than ex-situ tests. Micro tensile specimens will be prepared by focused ion beam (FIB) with interfaces in different orientations (such as aligned, perpendicular and inclined) to the loading axis and tested to compare the structure of interface in terms of misfit dislocations before and after deformation. These experiments will help to understand the dislocation glide behavior and other dynamic processes such as dislocation pile up at the interfaces and precipitation hardening processes in this alloy. This information aids in designing newer alloys best suited for high temperature application.

Task

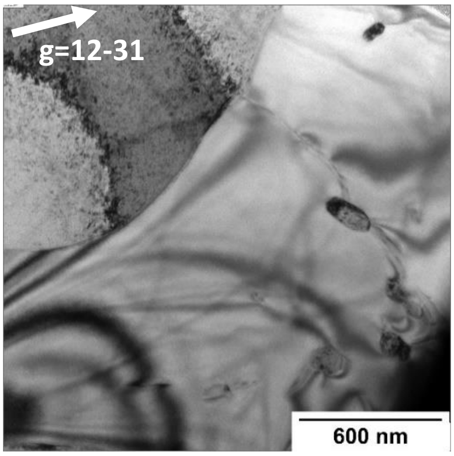

Fig. 1: TEM bright field image of a dislocation interacting with a molybdenum solid solution precipitate in the hexagonal, titanium rich silicide

The work is divided into the following steps:

- understanding of the role of dislocations and interfaces in plastic deformation
- performing the in-situ tensile tests in a transmission electron microscope
- characterization of dislocations and interfaces using high resolution transmission electron microscopy

Fig.2: In-situ single tilt heating and straining holder

Notes

We offer excellent supervision and the opportunity to work in an interdisciplinary team on a forward-looking topic. You must be able to work independently and be motivated to familiarize yourself with new topics. For further information, please contact Yolita Eggeler or Hemanth Thota.

TT.-Prof. Dr.-Ing. Yolita Eggeler   Hemanth Thota