INTERDISCIPLINARY CENTRE FOR ADVANCED MATERIALS SIMULATION

ICAMS Seminar

Dr. Florian Pyczak

Institute of Materials Research,
Helmholtz-Zentrum Geesthacht, Geesthacht, Germany

Monday, May 30, 4:30 p.m. ICAMS Seminar room UHW 11/1102

β-solidifying TiAl-alloys - phase constitution, metastable phases and nucleation processes

γ-TiAl alloys are attractive materials to replace heavier nickel-base superalloys for structural applications in automotive and aero engines at temperatures up to 750 °C and beyond. While actual high strength TiAl alloys of the so called 3rd generation have a better specific strength compared to nickel-base superalloys in that temperature range their ductility and damage tolerance is rather limited. In addition even this limited ductility is fully lost if parts from these alloys are not produced with an optimized microstructure. This is only possible by strict control of the processing conditions. To make reliable processing of these alloys easier certain alterations of the alloy composition can be made. These include a stabilization of the high temperature β phase as well as the introduction of minor elements like boron or carbon. While a combination of a fine grained, damage tolerant and ductile microstructure with high temperature strength can be achieved by this unfortunately the underlying mechanisms, present phases at different temperatures, etc. are far from understood. In a number of examples it will be shown, that the primary high temperature β-phase transforms to the low temperature phases involving a number of metastable phases as well as phases unknown from the binary Ti-Al phase diagram. Also the kinetics of grain refinement by heterogeneous nucleation at borides yields un-intuitive results like an increase of grain size with increasing cooling rate. Microstructure investigations by a number of advanced methods as for example high resolution transmission electron microscopy can give insight in some of these phenomena. Nevertheless, much future work is necessary to fully comprehend these mechanisms and benefit from them when developing improved TiAl-alloys in the future.