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Kinetics of grain arrangements controlled by grain boundary and triple junction migration-experiments and modeling

In several applications functionally oriented materials are exposed to extreme conditions. Large steam turbines are e.g. exposed to high temperatures. The higher the temperature of the hot temperature reservoir, the better is the efficiency factor and the lower is the CO_2 emission caused by the process. Line pipe steels as another example have to withstand high temperatures during welding. It is essential that the microstructures of these materials consist of fine, homogeneously distributed grains. Only then, the materials will have the desired mechanical properties. However, grain growth cannot be completely avoided at elevated temperatures. A possible strategy to retard grain growth to a certain extent is to micro alloy the steels with niobium and titanium. Niobium carbides and titanium nitrides nucleate at the grain boundaries and can effectively pin the grain boundaries. However, this phenomenon is only effective below a certain critical temperature. Normal grain growth is revealed below the critical temperature and abnormal grain growth above this temperature by an in-situ high temperature laser scanning confocal microscope. The kinetics of the motion of triple junctions and of whole grain arrangements is simulated based on the use of local constitutive equations. Not only distinct specific energies and mobilities can be assigned to the grain boundaries, but also finite mobilities can be assigned to the triple junctions. Thereby it is possible to interpret the results of the in-situ experiments in order to better understand the dissipative processes that occur during grain growth at elevated temperatures in micro alloyed steels.

Speaker Biography

Ernst Gamsjager has completed his PhD in 2002 and worked as a post doc with professor Militzer at the University of British Columbia, Canada and professor Fratzl, Max Planck Institute of Biomaterials, Germany. He obtained the Masing Memorial Award of the German Society of Materials Science in 2007. Since 2010, he works as an associate professor at University of Leoben, Austria. He has published around 50 papers in reputed journals, is member of the editorial board of "Metals" and is very active in reviewing manuscripts. He is member of the management committee of the Cost action CA15102 "Solutions for critical raw materials under extreme conditions".

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