MSE 2024

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Topic S: Structural Materials

S03: Metallic High Temperature Materials for Structural Applications

Transport, energy and many other fields do and will strongly rely on metallic high temperature materials. Even in a carbon dioxide neutral future there is need for e.g. materials withstanding the high temperatures in solar powerplants, operate in high temperature heat pumps for industrial exhaust heat, act as turbine blades in aero engines burning hydrogen or operate under the extreme conditions future fusion reactors will impose. However, until this transition is finished, cars and trucks with classical combustion engines still are in use worldwide and in Germany, fossil powerplants are an essential component to provide energy and electricity and airliners still burn gasoline, to name a few examples.

While many ceramics have higher temperature capabilities and better corrosion resistance or carbon fibres exhibit better specific strength, metals are the only materials offering the balanced set of properties to provide the necessary combinations of heat and corrosion resistance, creep strength, damage tolerance, etc. necessary to meet the demands of such applications.

Accordingly, research on metallic high temperature materials is a vivid field. Established material systems like steels and superalloys are still further developed benefitting from the new possibilities in modelling, characterisation or processing methods. In addition, new competitors like intermetallics and high entropy alloys are either in the process of introduction or evaluated to replace the established materials in some of their traditional applications. This is connected with ongoing efforts in alloy as well as process development to identify new materials, optimise properties, find reliable ways to produce parts from those materials and reduce their ecological footprint by suited repair and refurbishment processes. The research depends strongly on microstructure characterisation down to the atomic scale, materials testing emulating the harsh service conditions of high temperature applications and the use of different modelling and simulation methods. Only this combination of advanced characterisation and modelling methods provides the necessary data to understand the complex microstructure-property relationships of those materials and to make their knowledge-based development feasible.

Materials covered in the symposium include superalloys, steels, titanium alloys, other non-iron based alloys for high temperature applications including high and medium entropy alloys as well as the different structural intermetallics (TiAl, FeAl, NiAl, Nb-silicides, MoSiB,...). The symposium is open for contributions about the microstructure characterisation of those materials on all length scales, the determination of their properties especially with respect to mechanical strength and oxidation resistance as well as the prediction of those properties using different modelling and simulation methods. Contributions from the scientific as well as industrial side are welcome showing the close entanglement of basic and application related research in this field of materials science and engineering.

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