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Modeling and Simulation of Heterogeneous Materials: Microstructure and Properties

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With advanced manufacturing processes, such as additive manufacturing, it is possible to allow the fabrication of geometrically complex components. This can include objects with particular geometric patterns, such as lattice structures that can be designed to facilitate local adjustment of material properties, or even multiple materials in the same component. The properties of such heterogeneous materials can further be adapted to the application by tailoring the microstructure, e.g., through the processing route (manufacturing, heat treatment, etc.) and by adjusting the local chemical environment through targeted alloying.

Understanding the relationships between processing, microstructure, and resultant properties, as well as adequately reflecting them in modeling procedures is essential for a physical prediction of the mechanical behavior of heterogeneous materials. These properties include the elastic-plastic response, fracture toughness, fatigue, and thermo-mechanical load and residual stresses induced by manufacturing processes.

The focus of this symposium is the modeling and simulation of mechanical deformation of heterogeneous solid materials across different scales, which includes approaches aiming at providing a fundamental understanding of related physical processes, scale-bridging homogenization techniques, as well as methods which are focused on predicting mechanical properties on the macro-scale. Topics of interest include, but are not limited to:

- Multi-scale modeling of heterogeneous materials (particle reinforced materials, multi-phase materials, multi-material structures, ...)
- Mechanical behavior of lattice structures
- Material heterogeneity induced by additive manufacturing processing
- Generation of representative volume elements for heterogeneous solids
- Microstructure-property relationships in heterogeneous solids
- Property characterization of porous structures
- Modeling of materials with heterogeneous material composition

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