MS 3-2: Material instabilities

Organizers:
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Description of the symposium:

Material instabilities are a common occurrence in the solid mechanics. Numerous inelastic phenomena, such as plasticity, damage, and martensitic transformations, can be understood as macroscopic effects resulting from micro-scale instabilities. These instabilities are often associated with specific features of material behaviour, including softening (due to strain, thermal effects, or geometric changes) and/or non-associativity. Additionally, material instability is linked to sensitivity to small disturbances and imperfections, the lack of a unique response, and the emergence of nonuniform deformation patterns. Several observable phenomena arise from material instabilities: spontaneous localization of deformation, fracture initiation and failure in ductile materials, formation and evolution of microstructures, nano-scale phenomena with non-smooth characteristics, and surface and interfacial phenomena. As researchers attempt to describe material behaviour more accurately across multiple length scales, these instabilities drive the development of novel concepts and methods. These advances are motivated by the challenges encountered when applying standard approaches.

Material instabilities represent the key to the modelling and analysis of a number of observed phenomena: shear bands and localization of deformation; progression of compaction bands in ceramic powders and cellular materials; non-local or strain-gradient effects on instabilities; slip-system non-uniqueness and deformation banding in ductile single crystals; inhomogeneous slip distribution and dislocation clustering during plastic flow; creation or annihilation of interfaces during martensitic phase transformation; surface phenomena such as orange peel; and also large-scale failure processes occurring for instance during earthquake or landslide failures.

The aim of the mini symposium is to bring together scientists specialized in mathematical modelling and analysis, computational techniques, and experimental methods, related to material instability of any kind.