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Material Instabilities

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Mini-Symposium scope

Material instabilities occur frequently in the mechanics of solids. Considering the uniform straining of a material as a reference, material instability is linked to spontaneous localization of deformation, fracture initiation and failure in ductile materials, lack of a unique response, emergence of non-uniform deformation patterns, sensitivity to small disturbances and imperfections, formation and evolution of microstructures, and nano-scale phenomena of non-smooth nature. In the current trends to describe more and more accurately the materials behaviour over multiple length scales, instabilities can cause difficulties in applying standard approaches and enforce development of novel concepts and methods. This mini-symposium offers a forum for exchange of new ideas, approaches and results in all fields of experimental, theoretical and numerical studies related to material instability of any kind.

Material instabilities represent the key to the modeling of a number of natural and man-induced phenomena, as exemplified by: shear bands in metals,in granular or particulate suspension flow, in metallic glasses and thin films; progression of compaction bands in ceramic powders and cellular materials; non-local or strain-gradient regularization of localization of deformation;slip-system nonuniqueness and deformation banding in ductile single crystals;inhomogeneous slip distribution and dislocation clustering during plastic flow; pop-ins in nanoscale plasticity;creation or annihilation of interfaces during martensitic phase transformation; instabilities in liquid crystals and nematic elastomers; and also large-scale failure processes occurring for instance during earthquake or landslide failures.

The ubiquitous character of phenomena modeled as material instabilities and the fact that they typically involve multiscale interactions of microstructures has driven a strong research effort into this topic during the last twenty years, involving advanced techniques of nonlinear solid mechanics, new approaches to material instabilities of submacroscopically structured solids and fluids, homogenization theory, computational mechanics, bifurcation and stability in classical and non-classical materials and phases, scale-bridging material modelling, mathematical and numerical issues and experimental methods.

The research field is nowadays extremely active and crucial for the development of new technologies. The aim of the minisymposium is to bring together scientists specialized in mathematical modeling and analysis, computational techniques, and experimental methods, who will provide the most recent development in a field of crucial academic and industrial interest.