

The Stefan problem with a phase transition between visco-elastic fluids and finitely-strained solids

Tomáš Roubíček

(Charles University, Prague & Inst. of Thermomechanics, Czech Acad. Sci.)

The compressible fluid-solid interaction (FSI) with a thermomechanical phase transition is formulated at large strains in the Eulerian frame. The Jeffreys (also called anti-Zener) rheology in the deviatoric part with an additional viscosity is used. The main philosophy for the mechanical solid-liquid transition is that the viscous (or viscoplastic) response depends on temperature and may completely degenerate towards a viscoelastic fluid during thawing, which then allows for free flow of the fluid and its freezing in a new configuration and possibly again subsequent melting towards the fluid unlimitedly repeating such cycles. The classical Stefan problem related with the latent heat of the 1st-order (i.e. here thawing-freezing) phase transition is augmented by involving kinetic overheating and undercooling. The (sketched) analysis by a time discretization with a suitable truncation is applied to a higher-gradient modification of the original problem, i.e. involving the concept of multipolar nonsimple material. Some enhancements of the basic model as phase-field fracture in the solid phase or a diffusant dependency (like a salinity variation within the sea water/ice transition or a nickel content variation within the Earth inner/outer core transition) will be outlined, too.