The Stefan problem in a thermomechanical context with fracture and fluid flow

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Abstract

The classical Stefan problem, concerning mere heat-transfer during solid-liquid phase transition, is here enhanced towards mechanical effects. The Eulerian description at large displacements is used with convective and Zaremba-Jaumann corotational time derivatives, linearized by exploiting the additive Green-Naghdi's decomposition in (objective) rates. In particular, the liquid phase is a viscoelastic fluid while creep and rupture of the solid phase is considered in the Jeffreys viscoelastic rheology exploiting the phase-field model, exploiting a concept of slightly (so-called "semi") compressible materials. The L^1-theory for the heat equation is adopted for the Stefan problem relaxed by allowing for kinetic superheating/supercooling effects during the solid-liquid phase transition. A rigorous proof of existence of week solutions is provided for an incomplete melting, exploiting a time-discretisation approximation.

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