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Phase-field model of strain-induced grain-boundary premelting[1]
NAN WANG, ROBERT SPATSCHEK, ALAIN KARMA, Physics Dept and CIRCS, Northeastern University — Grain-boundary premelting depends in a complex way on the relative magnitude of the solid-liquid interfacial free-energy and grain boundary energy as well as temperature and strain. We study this dependence in a bicrystal geometry using a phenomenological three-order parameter phase-field model. This model describes the short scale attractive or repulsive interaction between crystal-melt interfaces and macroscopic linear elasticity including the important effect of the density contrast between solid and liquid. The model exhibits a rich behavior characterized by single or multiple premelting transitions between dry or wet grain boundaries with different liquid layer thicknesses as a function of applied tensile stress. The results have important implications for the phenomenon of liquid metal embrittlement associated with the stress-driven penetration of nanometric liquid films along grain boundaries.

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