Gurtin, Morton E.
Thermomechanics of evolving phase boundaries in the plane. (English) ｜Zbl 0787.73004｜
Oxford Mathematical Monographs. Oxford: Clarendon Press. xi, 148 p. (1993).

This very good book, presents a study of the dynamics of two-phase systems within the framework of modern continuum thermodynamics. The treatment is restricted to two-dimensional problems of non-deformable continua, in the absence of mass transfer.

The book has three parts: I. Kinematics; II. Mechanical theory of interfacial evolution; III. Thermodynamical theory of interfacial evolution in the presence of bulk heat conduction. The first part consists of three chapters: 1. Curves; 2. Evolving curves; 3. Phase regions, control volumes, and inflows. In part II, the mechanical theory is discussed. This part contains the chapters: 4. Balance of forces; power; 5. Energetics and the dissipation inequality; 6. Constitutive theory; 7. Digression: statical theory of interfacial stability; convexity, the Frank diagram, and corners; Wulff regions; 8. Evolution equations for the interface; basic assumptions; 9. Stationary interfaces and steadily evolving interfaces; 10. Global behaviour for an interface with stable energy; 11. Unstable interfacial energies and interfaces with corners; 12. Non-smooth interfacial energies; crystalline energies; 13. Regularized theory for smooth unstable energies; dependence of interfacial energy on curvature.

Part III presents a thermodynamical theory of interfacial evolution in the presence of bulk heat conduction. The theory is based on balance laws for force and energy in conjunction with an entropy-growth inequality that generalizes the classical Clausius-Duhem inequality. Part III contains five chapters: 14. Review of single-phase thermodynamics; 15. Thermodynamics of two-phase systems; 16. Constitutive theory; 17. Free boundary problems; 18. Instabilities induced by supercooling the liquid phase. The book also contains a bibliography and an index.

The book gives a detailed account of a number of important results in a field to which the author has made substantial contributions. Special problems and exercises are included. This monograph is a very useful work.

Reviewer: D.Iesan (Iaşi)

MSC:

74-02	Research exposition (monographs, survey articles) pertaining to mechanics of deformable solids
74A15	Thermodynamics in solid mechanics
80A22	Stefan problems, phase changes, etc.
35R35	Free boundary problems for PDEs

Cited in **1** Review
Cited in **122** Documents

Keywords:

kinematics; constitutive theory; instabilities; interfacial evolution; bulk heat conduction; interfacial energy; balance laws; two-phase systems