Peter Galenko

Phase Field Theory in Materials Physics

The Hodograph Equation

This book deals with the use of the hodograph equation in phase transformations in condensed matter, especially, for crystallization and solidification processes. The main focus of the book is the interpretation of the phase-field equations for isotropic and anisotropic interfaces based on the advanced Gibbs–Thomson and Herring conditions, respectively. Beginning with the basic ideas behind the extended irreversible thermodynamics, the kinetic phase-field model for slow and arbitrarily fast phase transformations is derived where the unified hodograph equation follows from:

- the sharp interface limit of the diffuse interface or
- the traveling wave solution of the propagating phase field.

Under the example of solute trapping and disorder trapping effects, comparing theoretical results with molecular dynamics simulations, and with the analysis of experimental data, the concrete workability of the developed hodograph equation is demonstrated for widest range of driving force in phase transformations.

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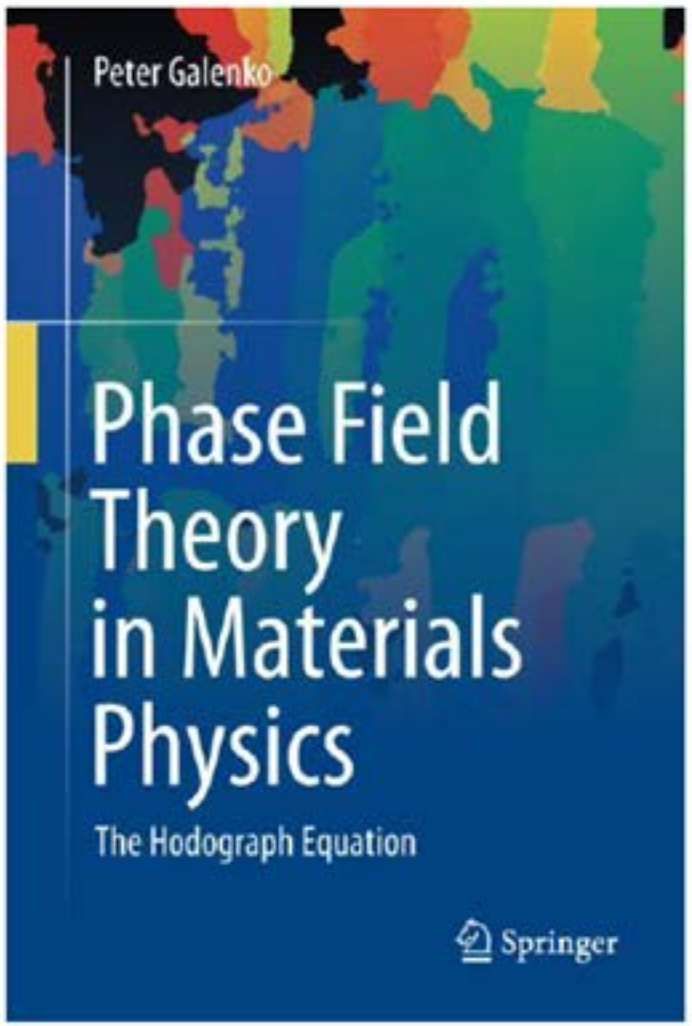

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- Introduces the hodograph equation in phase-field modeling of metallic melt solidification
- Features derivations dealing with interfaces of arbitrary morphology
- Benchmarks model results with both experimental and simulation data

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