

Mathematical models for phase change problems with hysteresis effect

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Abstract

The paper deals with a phase change problem which includes hysteresis effect. The system under consideration could be applied to various biological models by choosing appropriate conditions. Numerical simulations of the behaviour of solutions are presented.

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1. Introduction

In this paper, we consider the following system

$$\Theta_t + u\Theta_x - \kappa\Theta_{xx} + \text{div}_{K(u)}(\Theta) \ni \mathbf{F}(\Theta, u) \quad \text{in } (0, T) \times (0, 1), \quad (1)$$

$$u_t - u_{xx} = h(\Theta, u) \quad \text{in } (0, T) \times (0, 1), \quad (2)$$

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Mathematical Models For Phase Change Problems

**R. S. Anderssen, James M. Hill, A. K.
Pani**



Mathematical Models For Phase Change Problems:

Mathematical Models for Phase Change Problems J.F. Rodrigues, 2013-03-07 This monograph collects research and expository articles reflecting the interaction and the cooperation of different groups in several European institutions concerning current research on mathematical models for the behaviour of materials with phase change. These papers were presented and discussed in a Workshop held at Obidos Portugal during the first three days of October 1988 and grew out of a two year period of intensive exploitation of different abilities and mathematical experiences of the six participating groups namely in the University of Augsburg which was the coordination center of this project the Laboratoire Central des Ponts et Chaussées of Paris the Aristoteles University of Thessaloniki the University of Florence the University of Lisbon and the University of Oxford. This project was carried out under the title Mathematical Models of Phase Transitions and Numerical Simulation in the framework of twinning program for stimulation of cooperation and scientific interchange sponsored by the European Community. The underlying idea of the project was to create and study the mathematical models arising in applied engineering problems with free boundaries in a broad sense namely in melting and freezing problems diffusion reaction processes solid solid phase transition hysteresis phenomena mushy region descriptions contact problems with friction and/or adhesion elastoplastic deformations etc. This large spectrum of applied problems have in common the main feature of brusque transitions of their qualitative behaviour that correspond in general to non classical discontinuous monotone or non monotone strong nonlinearities in the mathematical equations.

Mathematical Methods and Models in Phase Transitions Alain Miranville, 2005 The modelling and the study of phase transition phenomena are capital issues as they have essential applications in material sciences and in biological and industrial processes. We can mention e.g. phase separation in alloys ageing of materials microstructure evolution crystal growth solidification in complex alloys surface diffusion in the presence of stress evolution of the surface of a thin film in heteroepitaxial growth motion of voids in interconnects in integrated circuits treatment of airway closure disease by surfactant injection fuel injection fire extinguishers etc. This book consists of 11 contributions from specialists in the mathematical modelling and analysis of phase transitions. The content of these contributions ranges from the modelling to the mathematical and numerical analysis. Furthermore many numerical simulations are presented. Finally the contributors have tried to give comprehensive and accurate reference lists. This book should thus serve as a reference book for researchers interested in phase transition phenomena.

Mathematical Modeling Of Melting And Freezing Processes V. Alexiades, 1992-11-01 This book begins with a precise formulation of the J Stefan problem for a melting freezing process based on the underlying physical processes taking place. It is devoted to the numerical simulation of phase change processes.

Mathematical Modeling Of Melting And Freezing Processes V. Alexiades, 2018-05-02 This reference book presents mathematical models of melting and solidification processes that are the key to the effective performance of latent heat thermal energy storage systems LHTES utilized in a

wide range of heat transfer and industrial applications This topic has spurred a growth in research into LHTES applications in energy conservation and utilization space station power systems and thermal protection of electronic equipment in hostile environments Further interest in mathematical modeling has increased with the spread of high powered computers used in most industrial and academic settings In two sections the book first describes modeling of phase change processes and then describes applications for LHTES It is aimed at graduate students researchers and practicing engineers in heat transfer materials processing multiphase systems energy conservation metallurgy microelectronics and cryosurgery

The Classical Stefan Problem S.C. Gupta, 2017-10-13 The Classical Stefan Problem Basic Concepts Modelling and Analysis with Quasi Analytical Solutions and Methods New Edition provides fundamental theory concepts modelling and analysis of the physical mathematical thermodynamical and metallurgical properties of classical Stefan and Stefan like problems as applied to heat transfer problems involving phase changes such as from liquid to solid This self contained work reports and derives the results from tensor analysis differential geometry non equilibrium thermodynamics physics and functional analysis and is thoroughly enriched with many appropriate references for an in depth background reading on theorems This new edition includes more than 400 pages of new material on quasi analytical solutions and methods of classical Stefan and Stefan like problems The book aims to bridge the gap between the theoretical and solution aspects of the afore mentioned problems Provides both the phenomenology and mathematics of Stefan problems Bridges physics and mathematics in a concrete and readable manner Presents well organized chapters that start with proper definitions followed by explanations and references for further reading Includes both numerical and quasi analytical solutions and methods of classical Stefan and Stefan like problems

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