

# 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

$$\Theta_t + u\Theta_x = \kappa\Theta_{xx} + \partial I_{K(u)}(\Theta) \ni F(\Theta, u) \quad \text{in } (0, T) \times (0, 1), \quad (1)$$

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

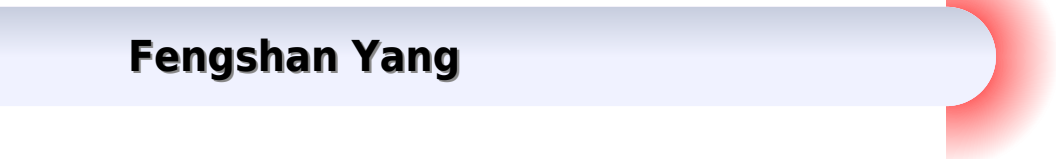
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# Mathematical Models For Phase Change Problems

**Fengshan Yang**



## **Mathematical Models For Phase Change Problems:**

*Mathematical Models for Phase Change Problems* J.F. Rodriques, 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 Models for Phase Change Problems** J.F. Rodriques, 1989-09-01

**Models of Phase Transitions** Augusto Visintin, 2012-12-06 What do you call work? Why ain't that work? Tom resumed his whitewashing and answered carelessly Well I like it and maybe it ain't. All I know is it suits Tom. Sawvc Oil CO I'll IOW Will do not mean to let 011 that you like it. The brush continued to move. Like it Well I do not see why I oughtn't to like it. Does a boy get a chance to whitewash a fence every day? That put the thing ill a little light. Ben stopped nibbling the apple. From Mark Twain's Adventures of Tom Sawyer Chapter II. Mathematics can put quantitative phenomena in a new light in turn applications may provide a vivid support for mathematical concepts. This volume illustrates some aspects of the mathematical treatment of phase transitions namely the classical Stefan problem and its generalizations. The intended reader is a researcher in application oriented mathematics. An effort has been made to make a part of the book accessible to beginners as well as physicists and engineers with a mathematical background. Some room has also been devoted to illustrate analytical tools. This volume deals with research I initiated when I was affiliated with the Istituto di Analisi Numerica del C.N.R. in Pavia and then continued at the Dipartimento di Matematica dell'Università di Trento. It was typeset by the author in plain TEX.

**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 *Handbook of Differential Equations: Evolutionary Equations* C.M.

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**of Electrical Circuits and Semiconductor Devices** Randolph Bank, R. Bulirsch, H. Gajewski, K. Merten, 2012-12-06 Progress in today's high technology industries is strongly associated with the development of new mathematical tools A typical illustration of this partnership is the mathematical modelling and numerical simulation of electric circuits and semiconductor devices At the second Oberwolfach conference devoted to this important and timely field scientists from around the world mainly applied mathematicians and electrical engineers from industry and universities presented their new results Their contributions forming the body of this work cover electric circuit simulation device simulation and process simulation Discussions on experiences with standard software packages and improvements of such packages are included In the semiconductor area special lectures were given on new modelling approaches numerical techniques and existence and uniqueness results In this connection mention is made for example of mixed finite element methods an extension of the Baliga Patankar technique for a three dimensional simulation and the connection between semiconductor equations and the Boltzmann equations *Phase Transitions and Hysteresis* Augusto Visintin, 2006-11-15 1 Phase Transitions represented by generalizations of the classical Stefan problem This is studied by Kenmochi and Rodrigues by means of variational techniques 2 Hysteresis Phenomena Some alloys exhibit shape memory effects corresponding to a stress strain relation which strongly depends on temperature mathematical physical aspects are treated in Müller's paper In a general framework hysteresis can be described by means of hysteresis operators in Banach spaces of time dependent functions their properties are studied by Brokate 3 Numerical analysis Several models of the phenomena above can be formulated in terms of nonlinear parabolic equations Here Verdi deals with the most updated approximation techniques **An Ethical Global Information Society**

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