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MOVING INTERFACES IN CRYSTALLINE SOLIDS

EDITED BY

FRANZ DIETER FISCHER
MONTANUNIVERSITÄT LEOBEN, AUSTRIA
AND
ERICH SCHMID INSTITUTE FOR MATERIALS SCIENCE,
AUSTRIAN ACADEMY OF SCIENCES, LEOBEN, AUSTRIA

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PREFACE

Materials with a changing microstructure are a matter of fact in many fields of materials research as well as in the application of materials in diverse fields of technical practice. Such a change may consist in one or more phase transformations in the material, the growth or shrinking of grains, or the appearance of the material in a different geometrical configuration like twinning. Both physical and thermomechanical activities are necessary to drive or stop or, better, to control such a process. The goal of the course "Moving Discontinuities in Crystalline Solids", on which this booklet is based, was to bring together experts from materials physics and materials mechanics to explain the fundamental phenomena of moving interfaces accompanied by the change of the material on both sides of the interface. The application of both classical and modern concepts of materials physics was demonstrated. Furthermore, the findings of continuum mechanics and numerical methods were discussed ranging from Eshelby's derivation of the thermodynamical force on an interface to numerical concepts under development for multiparticle, multicomponent systems. The authors of the various chapters, however, have tried hard not to present simply diverse concepts but to bridge the gaps between the numerous physical and mechanical approaches to this wide field of knowledge. Such a task is not easy and rather new. For many years researchers from mechanics and physics have tended to take different roads which met only by chance. Within the last fifteen years both groups felt that they had to come nearer, and finally, the authors of this booklet have the impression that they have come together. The inherent interdisciplinarity of the subject has been one of the strongest motivations to perform such a course and to write the booklet at hand. Computational methods, like the Monte Carlo Method, Ab-initio Modelling and "Enriched" Finite Elements have contributed a lot to a better understanding of what is behind the change of the microstructure. One may recognize this in the ever increasing number of courses, seminars, conferences and corresponding papers on "Modelling and Simulation". The authors also feel that the common view on the controlling mechanisms for the microstructure will have an increasing impact on industrial application. More effective materials that are better adapted to their respective functions and require shorter development times are more or less a must in the world of today's technology.

Some comments are also necessary with respect to the layout of this booklet. Since a group of researchers got together from different fields, very often their symbols and notations differ. A full unification would take too much time although it is a demanding task for the future. Therefore, the authors decided to write each chapter in a self-contained and self-explaining way with a list of notations at the beginning of the chapter. So each chapter has a textbook character starting from the basics and stating carefully the assumptions and limitations of the application of the theoretical framework. The authors try to present examples that are easy to understand. The

authors have also performed a mutual reading of their chapters with the goal to bring their own contribution in line with the related chapters.
The authors hope that the booklet will provide a sufficient basis for the understanding of this interdisciplinary field of materials mechanics and materials physics and will further mutual understanding. Both researchers and industrial developers should profit from this rather unique presentation of the motion of interfaces in solids.

The authors express their thanks to the Director of CISM, Prof. M.G. Velarde, for supporting the course with the staff of CISM and for the strong encouragement they received to write this booklet. Finally, the authors are grateful to Prof. C. Tasso for accepting this booklet for publication and his help in the editing.

Franz Dieter Fischer

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