

# Preface

Classical concepts and numerical methods of mechanical engineering such as, for example, fracture mechanics and finite element analysis focus on macro-scale problems where the microstructure is incorporated by using averaging constitutive laws. On the other hand, the domain of materials science and solid state physics focuses on investigation of atomic bonds, lattice defects, microstructural elements and their interactions at nano, micro and meso scales. However, a recent development in fracture and fatigue research clearly indicates that the most promising and effective concepts are based on coupling engineering mechanics with materials science within so-called multiscale fracture models. The objective of these approaches is to bridge the enormous gap between time and space scales and, therefore, they constitute a great challenge in the sense of scientific knowledge. Moreover, they still drive at psychological barriers of conservative mechanical engineers and/or material scientists. Therefore, an overwhelming majority of books about fracture and fatigue were written from the point of view of either mechanical engineers or material scientists. To our knowledge, a pioneering attempt to produce a successful integrated concept of fracture was made by Kelly and Macmillan [1]. Since that time, however, many new methods and concepts have been developed which should be incorporated into advanced multiscale models of fracture and fatigue.

This book was written as an overview of scientific results achieved by the authors during about 40 years of their research. However, another strong motivation was to support advanced trends in fracture and fatigue which lead to the development of multiscale concepts for securing the integrity of engineering components and structures. This second aim has always prevailed over the first. Therefore, the book is composed in a compact manner and provides a rather comprehensive survey of fracture micromechanisms and related multiscale models. Although these models were predominantly proposed by the authors of this book, many passages devoted to models that were published by other authors are included in order to ensure a consistent presentation of the subject. A prevailing part of the book reflects the joint work of authors

at the Brno University of Technology. However, several results and models originate from the research of the first author, performed at the Military Institute of Material Science and Technology from 1973 to 1985. The opportunity to present these results is much appreciated since, for obvious reasons, they were not allowed to be published in international scientific journals at that time.

The book addresses students at graduate and postgraduate levels, lecturers, materials scientists and mechanical engineers, as well as materials physicists and chemists. Any kind of criticism or advice that can help to improve the text will be very welcome.

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