The Theory of Transformations in Metals and Alloys

J. W. Christian
Pergamon (2002), 1216 pp.,
ISBN: 0-08-044019-3
$295 / €295

The third edition of this reference work represents a full revision by the author. It describes thermal and mechanical processes that produce extensive rearrangements of atoms in metals and alloys, and the resultant change in physical and chemical properties. Published as Parts I and II, it deals with lattice geometry, point defects, dislocations, stacking faults, and grain and interphase boundaries.

Numerical Modeling in Materials Science and Engineering

Michel Rappaz, *et al.*
Springer-Verlag (2003), 540 pp.,
ISBN: 3-540-42676-0
$89.95 / £56 / €79.95

This book introduces concepts and methodologies in modeling materials processing. The numerical methods of finite differences, finite volumes, and finite elements are described and developed for phase transformation, solid mechanics, and fluid flow problems. Inverse methods to obtain boundary conditions or materials properties are also covered.

Chemistry of Nanomolecular Systems

T. Nakamura, *et al.* (eds.)
Springer-Verlag (2002), 191 pp.,
ISBN: 3-540-44135-2
$69.95 / €59.95

Part of the *Springer Series in Chemical Physics,* this book gives an introduction to molecular electronics. It is divided into three parts, covering the synthesis of novel molecules for nanodevices, the evaluation of molecular systems with scanning probe microscopies, and background theory for the subject.

Expert

Graduate

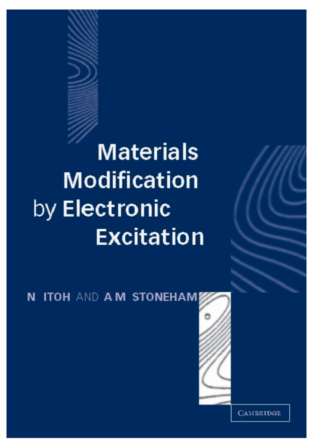
Undergraduate

Excited Materials

A comprehensive and thorough explanation of theory and experiment, *Materials Modification by Electronic Excitation* gives the reader a clear understanding of the field, says **Thomas Lippert**.

This book is very readable considering the enormous task the authors took on: discussing electronic excitation as a tool for modifying materials. To cover this huge field thoroughly, Itoh and Stoneham had to be selective in discussing materials, choosing inorganic non-metals. Organics and metals are mentioned from time to time as important correlated examples but, perhaps as a suggestion to the authors; it would be great to have a similar book for these materials.

Anyone who reads this book will have a clearer understanding what can and will happen in a material after electronic excitation. The summary on the book jacket states that it will be of particular interest to research workers in physics, chemistry, electronic engineering, and materials science. While it might be hard work for a chemist, it is written clearly in a style that is enjoyable and educational, and definitely would be worth the effort.



It starts with an excellent introduction, where all the basic concepts, such as polaron, exciton, structure, etc., are explained, followed by a summary of electronic excitation methods. It is worth mentioning that the authors' efforts to give credit to original work make the book a very good database for finding references.

Throughout the work, the aim is to combine discussion of experimental work with theory and modeling. Overall this works very well, possibly with a slightly stronger emphasis on theory than on experiment. I like especially the way the authors' deal with areas where different approaches exist. They often give a good reasoning for one approach, without saying that the other is wrong.

Various classes of materials are discussed in detail, after laying the groundwork for the important processes of energy deposition and redistribution, electron-lattice coupling, and self-trapping. These materials are divided into halides, oxides, and semiconductors, with an additional separation into amorphous and crystalline materials. This approach, probably the only possible one, is followed in the rest of the book. One example worth mentioning is the photographic process in silver halides. Itoh and Stoneham show clearly that, since the early work of Herschel in 1839, a lot of progress in understanding the process has been made, but that microscopic understanding is still incomplete. This is a fantastic example for an application outpacing fundamental understanding, and a plea for ongoing basic research on 'old' processes.

In the following two chapters, atom emission and surface modification and reactions at the interface are discussed, with a clear statement that a 'perfect' surface is hard to find in reality. This very often complicates the modeling of experimental data.

In the next chapter, a very different case is discussed, where the number of excitons, electrons, or holes can be of the order of the number of atoms. This is clearly different to the well-defined situations in the previous chapters. Processes, which are associated with the massive degree of excitation, include sputtering, laser annealing, and ablation. The most important concepts are discussed for laser ablation and, combined with a mesoscopic modeling approach, give very useful information about the process.

Noriaki Itoh and Marshall Stoneham
Materials Modification by Electronic Excitation (2002)
Cambridge University Press, 536 pp., ISBN: 0-521-55498-5
$150 / £95

The last chapter looks forward and briefly discusses various applications of material modification by electronic excitation.

What are the essential characteristics of this book? First, it is right up to date and accurate; second, it is interestingly written with all basic concepts at least mentioned. Last, but not least, the book shows how important the co-working of theory and experiment is. Without both of these our understanding of science would be very much lacking.

Thomas Lippert is head of the Materials Research Group at the Paul Scherrer Institut, Switzerland and private lecturer at the ETH Zurich.