### La Matière à l'Etat Solide: des supraconducteurs aux superalliages

*Edited by A. Guinier and R. Jullien*
*(Hachette, Paris, 1987)*

Andre Guinier wrote an earlier book in 1980 for the same series, (Liaisons Scientifiques), as the new volume now under review. That earlier volume, titled *La Structure de la Matiere - du ciel bleu a la matiere plastique,* surveyed the atomic physics of the solid state for pupils at the top end of the French schools, and it contrived to do this without mathematics or quantum theory. It has now been published in English translation by Edward Arnold, London.

The new book builds on the earlier one, and sets itself the central aim of relating macroscopic properties to atomic and crystallographic structure. This time, quantum mechanics and advanced mathematical treatments are both included; the latter are restricted to a few specific relationships which are treated fully but segregated in boxes away from the main flow of text.

Topics treated include: thermal capacity, expansion and conduction; electric conductivity of all kinds of solids, dielectric behavior, superconduction (there was even time to insert a last-minute reference to the new oxides), and molecular conductors; the various manifestations of magnetic behavior; atomic diffusion in solids; and the different variants of mechanical behavior, elastic and plastic.

The first chapter, on thermal properties, is particularly clear and compares classical ideas with the Einstein and Debye models. Brillouin zones are introduced at this stage instead of waiting for the "electrical" chapter to do so. Phonons make their appearance and there is a lucid introduction to the acoustic and optical branches, and the behavior of polyatomic molecules is presented in detail. Whenever a critical youngster might feel that hands are perhaps being waved a little, his presumption is promptly quenched with a new mathematical "box," always very opposite to the argument in hand.

The other physical chapters are likewise beautifully lucid and systematic. The pace and character of the book changes when it comes to discussing mechanical properties. The authors remark in their "avant-propos" that this type of theme is usually segregated in books of "tendance métallurgie," but imply that there is no need for such segregation, in that it merely reflects conventional departmental distinctions. I am not so sure...the change of gear when mechanical properties come to be discussed shows how difficult it is to apply the same rigorous approach that a solid-state physicist is used to to the mechanical behavior of realistic, defective solids. (The mathematical "boxes" here are few and restricted to simple, highly idealized situations.) If one looks at some of the classics of this subfield, such as Cottrell's early book on *Dislocations and Plastic Flow in Crystals* or his later *Mechanical Properties of Matter,* one finds that there is a choice to be made: either one remains elementary, and qualitative, or one shows the true rigor of the modern approach, but at the necessary cost of sophisticated models, elaborate elastic theory and an unavoidable loss of brevity. In spite of their much less quantitative approach here, the authors of the French book nevertheless succeed in giving a good concise overview of realistic mechanical properties and associated problems.

There is of course a psychological problem implied by the gear change I have referred to: in both France and the United Kingdom, there is a paucity of good students coming forward to study metallurgy and materials science, and if the ablest sixth-formers are reinforced in their fallacious suspicion that metallurgy (especially mechanical metallurgy) consists of qualitative arguments and excessive simplifications, they will all go off to prepare themselves for CERN, Mt. Palomar or the Bohr Institute. In America, the same problem exists but is put right because of the existence of excellent graduate schools in materials where many physicists learn the true rigor of modern materials science before going on to undertake research.

There is one other respect in which this book, taken with its predecessor, gives a not quite balanced view of the nature of materials science. There is little on microstructure and nothing on phase transformations, and yet these two topics constitute the heart and essence of materials science. True, the books are concerned with being rather than becoming (if the Sartrean touch may be forgiven), and phase transformations are par excellence concerned with becoming. Perhaps the authors are planning a third volume to focus on these two subjects, and if so, they are strongly to be encouraged!

Nevill Mott, in his (English-language) preface to the book, commends it warmly but refers to the long-standing and unresolved argument in Britain about the propriety of teaching quantum theory to schoolboys. In France, it seems that reform on these lines is closer to realization than in Britain. In spite of the problem I have adumbrated above, this is a splendid book by two masters of their field, and when taken in conjunction with the earlier book it offers a stimulating and comparatively painless approach to many of the fundamentals of modern materials science.

It is to be hoped that this new book will likewise be published in an English version.

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