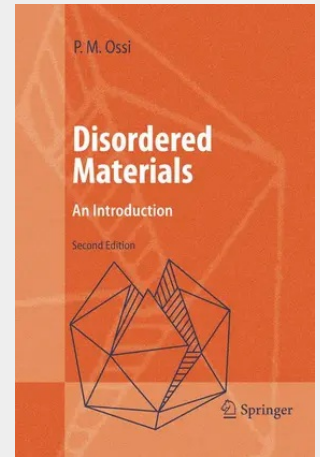


Disordered Materials

An Introduction

The teaching of solid state physics essentially concerns focusing on crystals and their properties. We study crystals and their properties because of the simple and elegant results obtained from the analysis of a spatially periodic system; this is why the analysis can be made considering a small set of atoms that represent the whole system of many particles. In contrast to the formal neat approach to crystals, the study of structurally disordered condensed systems is somewhat complicated and often leads to relatively imprecise results, not to mention the experimental and computational effort involved. As such, almost all university textbooks, - cluding the advanced course books, only briefly touch on the physics of am- phous systems. In any case, both the fundamental aspect and the ever wider industrial applications have given structurally disordered matter a role that should not be overlooked. The study of amorphous solids and their structure, stability and properties is a vibrant research branch; it is difficult to imagine how any physicist, chemist or engineer who has to deal with materials could possibly ignore this class of systems. The author of Disordered Matter – an Introduction uses this course book at the Politecnico in Milan, Italy. Collecting the material for the course proved no mean task, leading him to have to prepare ad hoc didactic material. The continual exchange between teacher and student has led to the present version of the book.

This self-contained text introduces the physics of structurally disordered condensed systems at the level of advanced undergraduate and graduate students. Among the topics are the geometry and symmetries of the structural units used as building blocks of extended structures, the various kinds of disorder, the phenomenology and the main theories of the glass transition, the structure of amorphous systems and the techniques to investigate it, the evolution of system's structure with its size (clusters) and the presence of orientational order in the absence of translational order (quasicrystals). In the second edition, the treatment of the mode coupling theory of the glass transition has been enlarged and connects now to a new section on collective excitations in disordered systems. Special attention has been devoted to nanometer-sized disordered systems, with emphasis on cluster-assembled materials. Questions of what governs the occurrence and stability of quasicrystals, the features of the amorphous to quasicrystal transformation and its reverse transition are discussed. The conditions leading to nano-quasicrystalline phases of technological interest are examined. Throughout the text relevant recent experimental and theoretical results are discussed so as to give readers insight into the currently most vibrant research topics. From the reviews of the first edition: "The text is clearly presented, amply illustrated and has approximately 45 references with an equivalent amount of further reading [...] it provides a fresh viewpoint which makes it well worth careful reading. [and] provides a stimulating and novel coverage of a difficult subject area." Glass Technology



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