Kinetic Processes: Crystal Growth, Diffusion, and Phase Transitions in Materials

Kenneth A. Jackson
John Wiley & Sons (2004), 424 pp.
ISBN: 3-527-30694-3
$130 / £70 / €105

Jackson covers the kinetic processes that govern the formation of solids. He connects the basic processes at the atomic level to material properties. Diffusion processes during crystal growth and phase transitions are discussed, along with approaches often used to approximate the complex mathematics. An emphasis is placed on the growth of thin films and bulk crystals because of their importance to the semiconductor industry.

Characterization and Measurement of Magnetic Materials

Fausto Fiorillo and Isaak Mayergoyz
Academic Press (2004), 500 pp.
ISBN: 0-12-257251-3
$175 / £100

This book describes the methods used to measure hard and soft magnetic materials. It also presents an overview of the properties of these materials. Soft amorphous alloys, Fe-based rare earth magnets, and giant magnetoresistive materials, which have all found applications in devices on the market, are discussed.

Physics of Transition Metal Oxides

S. Maekawa, *et al.*
Springer (2004), 337 pp.
ISBN: 3-540-21293-0
$129 / £77 / €99.95

Transition metal oxides are used as magnets, in electronics, and include high-temperature superconductors. This book covers the basic physics underlying their properties. It reviews recent progress in spintronics, colossal magnetoresistance, strong electron correlation, and the metal-insulator transition.

Expert
Graduate
Undergraduate

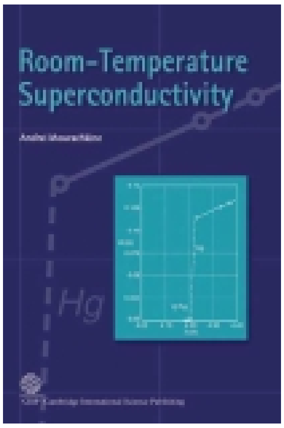
A challenging read

Andrei Mourachkine uses his new book to argue that superconductivity could be achieved at room temperature and, while his thesis may rest on some unconfirmed evidence, it does challenge preconceptions, says **Cathy Foley**.

Superconductivity is one of physics' most intriguing and exciting research areas. The catch is that such materials must be cooled below a critical temperature for the properties to be observed. The idea of achieving superconductivity without cooling is usually considered science fiction. But is it?

Andrei Mourachkine has written a very exciting and inspiring book entitled *Room-Temperature Superconductivity*. In this book, he presents his thesis on why room temperature (RT) superconductivity should be possible and outlines the requirements for engineering such a material.

At first, my initial thought was that this was a crazy idea. However careful reading has made me rethink this reaction. Realizing that most people will have a similar reaction, Mourachkine asks the reader to suspend judgment. Unfortunately, his book comes across as being written by a physicist with a chip on his shoulder. On one hand, it is a pity that this paranoia was not removed during the editing process, while on the other, it did make me rethink my initial prejudice to the book.



The book has a very engaging introduction that weaves history and science, and provides a flavor of the bewilderment of the physics fraternity as they struggled to understand what Mourachkine calls 'nature's oversight'. The author also presents some very speculative ideas as well as new and, as yet, unverified concepts of organic superconductivity, which he believes is key to developing RT superconducting materials.

Regardless of your willingness to agree with this speculation, the book provides a high quality but poorly referenced outline of the physics of superconductivity. Chapter two begins with the basic properties of the superconducting state and is an excellent introduction for any student of physics. Chapter three reviews superconducting materials and chapter four discusses the four principles of superconductivity. Chapters five, six, and seven consider the specific physical mechanisms for the three classes of superconductivity.

The last three chapters present the author's main hypothesis that RT superconductivity should exist as a consequence of the existence of Cooper pairs, since these quasiparticles are bisolitons – an electron (or hole) pair coupled in a singlet state as a result of local deformation of the conduction plane. Chapter eight focuses on bisolitons in organic matter. Most of the argument is based on a review paper on solitons in conducting polymers [Heeger *et al.*, *Rev. Mod. Phys.* (1988) **60**, 781], an unpublished preprint, and a paper on carbon nanotubes [Tang *et al.*, *Science* (2001) **292**, 2462]. Chapter nine considers phase coherence, has no references, and is mainly speculation. Chapter ten is the most exciting, presenting the requirements for RT superconductivity and three approaches to achieving it. This again is speculative, but gives food for thought. Unfortunately, it is not well referenced and relies heavily on preprints and unrefereed publications.

Nevertheless, *Room-Temperature Superconductivity* is a good read. It is inspiring while challenging. I think that the author is sometimes naive and shows blind faith in handling some of the literature. In some cases he has referenced papers that have been discounted by subsequent research that he has not cited [e.g., Kasumov *et al.*, *Science* (2001) **291**, 280 has been discounted by several research groups as summarized in *New Scientist* (29 March 2003), 17]. However, the basic theory is enjoyable to read and makes a good starting point for someone who wants to have an initial understanding of the research field. I think the references and the lack of rigor lets it down, but the book has been written to challenge the physicist and materials scientist and to bring together molecular science and superconductivity in seeking a RT superconducting material.

Andrei Mourachkine
Room-Temperature Superconductivity
Cambridge International Science Publishing (2004), 326 pp.
ISBN: 1-904602-27-4, $125 / £80

Cathy Foley is a research physicist at the Commonwealth Scientific and Industrial Research Organisation, Australia.