Molecular Materials

The class of compounds called molecular materials (MMs) has grown enormously in the last few years, extending into areas that were previously a monopoly of inorganic materials. Books covering the subject are welcome, because understanding MMs requires a physical understanding of the properties, which might be challenging for a synthetic chemist. At the same time, synthetic aspects might be difficult for a physics-orientated researcher. So the initiative of the three editors, D. W. Bruce, D. O'Hare, and R. I. Walton, to include a book on MMs in the series *Inorganic Materials*, must be greeted with enthusiasm.

Chapter 1, by O. Maury and H. Le Bozec, is devoted to metal-based quadratic nonlinear optical materials. The field is covered thoroughly and with an adequate amount of detail, starting from the beginning in the late 1980s and extending up to now. It is well written, with a section devoted to the basic principles of nonlinear optical properties and experimental techniques for measuring optical activity. The main classes of nonlinear optical materials, based on dipolar, quadrupolar, and octupolar approaches, are discussed.

Chapter 2, by K. Binnemans, is about metallomesogens. The focus is on the physical properties of mesophases containing metal ions, especially the magnetic and optical properties, an area that has developed rapidly in the last few years. An important step forward was achieved by the use of synthetic techniques that made it possible to synthesize metallomesogens at temperatures not far from room temperature. The properties are described in a simple way, introducing only the minimum theory needed. For example, the luminescent and magnetic properties of lanthanide derivatives, a topic that is not easy to present, is treated in a very efficient way.

Magnetic properties are the focus of Chapters 3, by N. Robertson and G. T. Yee, and 5, by R. E. P. Winpenny and E. J. L. McInnes, in accordance with the wide current interest in molecular magnetic materials (MMMs). The authors of Chapter 3 have the difficult task of introducing the magnetism of transition-metal and lanthanide ions from scratch. It is by no means an easy assignment, but they succeed in condensing within a few pages the concepts that occur frequently in the jargon of magnetism. In fact, this chapter is the one that is closest to being a "book chapter", the others being nearer to the style of a review. Several MMMs are discussed in detail in a clear simple way. I would have expected something more on p-orbital magnetism, but space limitations probably prevented that.

Chapter 5 is about molecular nanomagnets (MNMs), one of the success stories of molecular magnetism. MNMs are molecules that contain at least one magnetic center, and have magnetic properties that are a blend of classical and quantum-mechanical types of behavior. The so-called single-molecule magnets (SMMs), consisting of molecules whose magnetization is blocked at low temperatures, like the behavior of a bulk magnet, are now attracting much interest. As the authors point out, a magnetic tape using SMMs could store music for 150 years. In a brief section, the authors review the main theoretical and experimental techniques needed for understanding MNMs. SMMs are described in detail. The last section of the chapter is devoted to emerging trends, such as quantum information processing and molecular spintronics.

Chapter 4, by L. Valade and H. Tanaka, reports about advances in molecular inorganic conductors and superconductors. The chapter begins by reviewing the main families of organic materials and the criteria for designing their properties. That is followed by a detailed review of materials based on metal bis-dithiolene complexes. The fourth section is concerned with applications. Inorganic materials are at an earlier stage of development compared to organic systems, but significant advances are reported.

In 1999 the Royal Society of Chemistry published a book entitled *The Age of the Molecule*, which emphasized the great potential of molecular chemistry in many different fields. The present book confirms that the view is correct, even if applications are difficult to forecast. However, the book does an excellent job of putting together several different classes of materials. Many common points emerge, and the book may facilitate the development of hybrids in which the qualities of the "parents" are enhanced.

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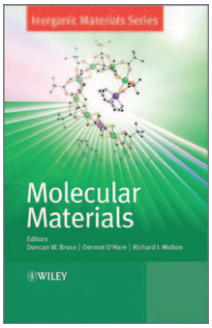

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