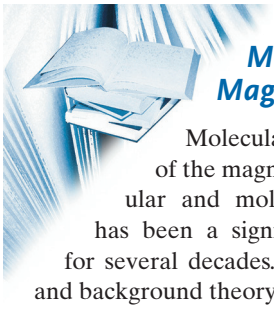

Introduction to Molecular Magnetism

Molecular magnetism—the study of the magnetic properties of molecular and molecule-based materials—has been a significant area of research for several decades. Early areas of interest, and background theory, were covered in Kahn's textbook of 1993.[1] The field expanded dramatically in the early-mid 1990s with the discovery that certain molecules—now known as single-molecule magnets (SMMs)—had a magnetic memory effect of a purely molecular origin. Famously this led to the discovery of magnetization quantum tunneling and quantum phase interference effects, and the field became as interesting to physicists as it was to chemists. Much of that work was dominated by d-block transition metal clusters, partly because the latter (at least the spin-only ions) are more amenable to theory and modeling. A thorough survey of the theory and experimental results was given in a 2006 textbook by one of the authors of the current text.[2]

The new textbook by Benelli and Gatteschi is not simply an update of that earlier book. It reflects the major shift in the area over the last 10 years or so, when many of the important discoveries—including increased thermal barriers to magnetic relaxation in SMMs, coherent single electron and nuclear spin control, and the demonstration of molecular spintronic effects—have involved lanthanide (Ln) ions. Hence, a substantial proportion of the book is given to discussing the magnetic properties of 4f ions and laying out the underlying electronic structure theory. This is necessarily more complicated than treatment of simple spin-only ions, and a new text in this area that doesn't assume huge pre-knowledge on the part the reader is most welcome.

After a brief historical account of molecular magnetism, the text covers the basics of electronic structure for isolated d- and 4f-block metal ions (crystal field theory, spin–orbit coupling, Zeeman effect, magnetic anisotropy), spin Hamiltonians and their limitations, molecular orbital treatments, exchange interactions, dynamic magnetic properties (relaxation), and some discussion of experimental and computational methods of study. The treatment of orbitally degenerate ions, isolated and coupled, is embedded in these chapters and not separated away in one easily avoidable chapter—this is a very good thing! The focus is on lanthanides but orbitally degenerate d-block ions, particularly six-coordinate cobalt(II), are also discussed.

The later chapters deal with some of the most recent areas of research in molecular magnetism and which might be less familiar to those coming into the field from, say, a synthetic chemistry background. These chapters, with really excellent beginners' guides, are a major strength of the book, and the areas covered include molecular spintronics, quantum information processing, magnetocalorics, Ln-based SMMs and single-chain magnets. Dysprosium has become such a ubiquitous target of study that it gets its own chapter. Some longer-established research areas are also covered, including lanthanide applications in NMR and MRI.

The scope of the book is therefore really rather broad, but it covers all the important areas. A newcomer to the field will get a good overview of modern research in molecular magnetism and get a clear path into the primary literature and more specialized texts. They will also find out what theory they need to learn if they want to understand the magnetic properties of lanthanide materials beyond a superficial level. Being critical, there are some unfortunate typos that hopefully will be corrected or highlighted in errata, and the resolution of some of the figures could be higher. It is not always an easy read, but then the material being covered is not trivial and this is why the book is necessary. The authors have made huge contributions to the understanding of magnetic properties of molecular materials and they are also excellent educators. An interested reader—of any experience—cannot fail to learn from them if they are willing to do so.

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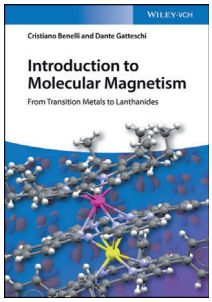
[1] O. Kahn, *Molecular Magnetism*, VCH, New York, **1993**.
[2] D. Gatteschi, R. Sessoli, J. Villain, *Molecular Nanomagnets*, Oxford University Press, **2006**.



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