Preface

The rare earth elements together with scandium, yttrium and lanthanum fill 17 places in the periodic table. Besides the transition metals, they comprise one of the large groups of elements for functional materials in inorganic, solid state, coordination and organometallic chemistry. The rare earth elements are not as rare as their name might imply, and we all commonly use rare earth-based materials in daily life. Typical applications are all kinds of luminescent materials for LED lighting, small permanent magnets in headsets, large magnets in wind turbines, rare earth-based alloys, metal-hydride batteries for hybrid engines, gadolinium contrast agents in tomography, laser crystals, lambda oxygen sensors in exhaust gas technology or LCD screens.

Besides these few examples, the rare earth elements dominate the fields of materials research and catalysis. Meanwhile, about 80% of the current material-based patents at least partly include a rare earth-based function. The gross market for modern functional materials based on rare earth elements includes: (i) metallurgy including alloys and permanent magnetic materials, (ii) glass and ceramics including polishing materials, (iii) chemicals and catalysts and (iv) phosphors and electronics. The production of and demand for rare earth metals have shown strong increases since many years, and one can without doubt count rare earth-based industry among the basic future technologies.

Although of extraordinary technological importance, rare earth chemistry is still poorly treated in most inorganic chemistry textbooks. In view of the high impact on the gross domestic products, basic knowledge on the rare earth elements and rare earth-based materials should be a prerequisite for a chemist, physicist and materials scientist. Over the last forty years, high-quality review articles on the many facets of rare earth functionalities have been published in the famous *Handbook on the Physics and Chemistry of Rare Earths* [1]. The present initiative is not just another compilation on rare earth functionalities and rare earth materials. It is meant as an introduction to this broad field on the level of senior undergraduate and postgraduate students. An inevitable prerequisite for the study of this book is the knowledge of some basic chemistry and physics.

This textbook covers fours main chapters: (i) *The Elements*, (ii) *Reactivity and Compounds*, (iii) *Characterization and Properties* and (iv) *Materials and Applications*, addressing many important aspects of rare earth chemistry. Due to the enormous combinatorial variety of the elements, it is impossible to know and consider all classes of rare earth compounds. Nevertheless, we hope that we have made a good compromise and covered most of the basic knowledge on rare earth materials. The chapters are written by leading scientists who are all experts in the topics of their individual contributions. They present a broad literature overview. The interested reader can use this secondary literature (books and review articles) for further in-depth information.

https://doi.org/10.1515/9783110654929-202

Such a book project is not realizable without the help of colleagues and co-workers. We thank Gudrun Lübbering for continuous help with literature search. We are especially grateful to our colleagues for their immediate consents to write up a chapter. It is always challenging to compile a concise Table of Contents and find suitable coauthors. We are indebted to the editorial and production staff of de Gruyter. Our particular thanks go to Kristin Berber-Nerlinger and Dr. Vivien Schubert for their continuous support during conception, writing and producing the present book.

Münster, Steinfurt, 01 May 2020
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[1] J.-C. G. Bünzli, V. K. Pecharsky (Eds.), Handbook on the Physics and Chemistry of Rare Earths, Volumes 1–54, North-Holland, Elsevier, Amsterdam, 1978–2020.

This book contains a token, pointing to:

recommended literature for further reading;
i. e. relevant text books, review articles or important original articles