Preface

Recent decades have witnessed rigorous research in the field of optical materials that have made possible the development of innovative luminescent materials for numerous practical applications. Advances in synthesizing, characterizing, and applying single crystals, polycrystalline powders, and functionalized nanoparticles have helped novel technologies as bioimaging, optical thermometry, photonics, and optoelectronics. Such research has also contributed to the development of commercially useful phosphors for white light light-emitting diodes (LEDs) and to persistent phosphors with high storage capacity.

The selection of luminescent material for practical applications starts by specifying the various requirements of a particular device. The selection of the optical material satisfying the pertinent requirements starts by the fundamental understanding of the enabling physical process. In recent years, researchers have been productive in advancing the fundamental understanding of structure–optical property relationships which serves as a practical guide to the selection of optical materials. The impetus for publishing this book emerged a few years back as we felt that researchers could benefit from an up-to-date review of optical materials in emerging fields along with advances in fundamental understanding of the physical process and spectroscopic properties. We approached this by inviting leading experts to write individual chapters on different topics, which are at the cutting edge of modern optical materials research. It is our sincere hope that the book will prove useful to both experienced and young researchers in understanding and designing luminescent materials and will help them in the different stages of their research careers.

The book consists of 11 chapters, which are authored by scientists with backgrounds in industry and academia. A short description of the chapters is given as follows:

Chapter 1 (M. G. Brik, A. M. Srivastava, and W. W. Beers) discusses some basic concepts and nomenclature or branches of luminescence by defining the terms that are used to identify various ways in which luminescence is generated with respect to the excitant. The chapter also briefly discusses a few examples of photoluminescence.

Chapter 2 (Israel F. Costa, Lucca Blois, Albano N. Carneiro Neto, Ercules E. S. Teotonio, Hermi F. Brito, Luís D. Carlos, Maria Claudia F. C. Felinto, Renaldo T. Moura Jr., Ricardo L. Longo, Wagner M. Faustino, and Oscar L. Malta) focuses on further developments of Judd–Ofelt theory in its application to the lanthanide ions and reinterpretation of the intensity parameters.

Chapter 3 (Markus Suta and Werner Urland) gives an overview of crystal and ligand field theories and explores the angular overlap model of the ligand field theory for the description of the electronic structure of coordination compounds.

Chapter 4 (Jiance Jin and Zhiguo Xia) is devoted to all-inorganic metal halide perovskites, their synthesis as nanocrystals and bulk crystals along with their luminescent property and mechanism, as well as applications in photonics.

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Chapter 5 (A. Siva Sesha Reddy, M. Kostrzewa, N. Purnachand, G. Sahaya Bhaskaran, N. Venkatramaiah, V. Ravi Kumar, and N. Veeraiah) explores the influence of free volume space defects as estimated by positron annihilation spectroscopy on the luminescence efficiency of Ho^{3+} ions in Au_2O_3-doped $PbO–B_2O_3–SeO_2$ (PBS) glass ceramics.

Chapter 6 (Jumpei Ueda) discusses the fundamentals and applications of persistent luminescence in Ce^{3+}-doped garnets. Fundamental approaches to controlling and devising new persistent phosphors are presented.

Chapter 7 (Gabrielle A. Mandl, Gabriella Tessitore, Steven L. Maurizio, and John A. Capobianco) brings to the reader's attention the fundamental properties of luminescent nanoparticles based on lanthanide and transition metal ions for bioimaging applications. Imaging based on near-infrared emission, upconversion, and persistent luminescence is discussed.

Chapter 8 (Veeramani Rajendran, Ho Chang, and Ru-Shi Liu) is about the application of two transition metal ions with $3d^3$ electronic configuration, Mn^{4+} and Cr^{3+}, as generators of red and infrared phosphors in LED applications. The applications include general lighting and displays.

Chapter 9 (Florian Baur and Thomas Jüstel) deals with the fundamentals and uses of ultraviolet (UV)-emitting phosphors that are excitable by practical UV radiation sources such as Hg low-pressure discharge, excimer discharge, and LEDs. Phosphors for UVA, UVB, and UVC are discussed.

Chapter 10 (Philippe Boutinaud and Enrico Cavalli) discusses the advancements made in the fundamental understanding of the metal-to-metal charge transfer transitions between cations of oxidic hosts and Pr^{3+} or Tb^{3+} ions, when doped in oxidic compounds which are composed of cations with the d^0 and d^{10} electronic configurations. Application of such systems in optical thermometry is also discussed.

Chapter 11 (A. M. Srivastava, M. G. Brik, and W. W. Beers) presents and summarizes the considerable body of experimental and theoretical data that are available on the luminescence of the Bi^{3+} ion in materials with the orthorhombic perovskite and double perovskite structures. The chapter provides an understanding of the behavior of the Bi^{3+} ion in relation to the composition and electronic structure of the host crystal.

We would like to take this opportunity to express our sincere gratitude to all contributors to this book. Without their hard and intensely focused work, the book would not have become possible. We also thank the staff members at De Gruyter for their help and guidance during our collaborative efforts on this book. It has been an interesting and challenging adventure, and it is satisfying to reach the point at which the book is finalized and ready for production. We wish the readers an interesting journey through the book pages.

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