Foreword

Rare earth metal salts are often found difficult to handle due to their strong oxophilicity, which makes them hygroscopic and reactive toward oxygen. However, this problem can be overcome by using specified lab equipments such as vacuum lines, glove boxes, etc. The catalytic applications of rare earth metals and salts have been extensively studied in C–H and C–F bond activation reactions, photocatalysis, lanthanide–halide exchange reactions, dinitrogen conversion, and most importantly for the synthesis of biologically promising carbocyclic and heterocyclic scaffolds. Many new transformations have been reported using rare earth metal salts as the catalyst. These applications have opened up the way to several new transformations in organic synthesis using rare earth metals in various oxidations states either in catalytic or in stoichiometric amounts.

Under this purview, I personally believe that this book entitled *Rare Earth Elements: Occurrence, Catalytic Applications and Environmental Impact*, edited by Prof. Basudeb Basu and Dr. Bubun Banerjee, is going to be a valuable resource for the researchers working in the fascinating fields of rare earth metals. The main aim of this book is to showcase the versatile applications of rare earth metals in various organic transformations. Moreover, bio-applicability, industrial applications, and environmental impact of rare earth metal salts have also covered in this book.

The first chapter describes the occurrence, environmental impact, and catalytic applications of various yttrium complexes for diverse organic transformations. Chapter 2 deals with the uses of half-sandwich organo rare earth metal–alkyl complexes as catalyst for the formation of various C–C bonds via C–H bond functionalization while the Chapter 3 demonstrates various rare earth metal-catalyzed one-pot multicomponent reactions. Chapter 4 focuses on the preparation and catalytic applications of light-weight rare earth metals in combination with *N*-heterocyclic carbine complexes. Chapter 5 summarizes the recent applications of lanthanum triflate as catalyst for various organic transformations. Catalytic role of various actinide complexes for useful organic transformations is described in Chapter 6. Chapters 7 and 8 provide elaborative literatures related to the catalytic applications of samarium and erbium-based compounds, respectively, in organic transformations. Chapters 9 and 10 summarize the catalytic applications of various rare earth metal trfilates, namely, gadolinium, scandium, and lanthanum triflates. The cerium(IV) ammonium nitrate (CAN)-catalyzed

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synthesis of structurally diverse *O* and *S*-heterocycles is described in Chapter 11. Chapter 12 specially deals with the uses of rare earth metal complexes as efficient photocatalysts in organic synthesis. Chapter 13 focuses on updates about the various innovative as well as environmentally benign techniques utilized for bioremediation of rare earth elements to protect our mother Nature. Chapter 14 provides an up-to-date literature related to the biomedical applications of various rare earth elements. The final chapter shows the ways to the recovery of rare earth elements from electronic waste.

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About Professor Asit K. Chakraborti

Professor Asit K. Chakraborti has been a founder faculty of National Institute of Pharmaceutical Education and Research (NIPER), S. A. S. Nagar, Mohali, Punjab, India, and had been intimately associated with the development of this pioneering institute of the country in the fields of pharmaceutical education and research. He is currently Raja Ramanna Fellow in the School of Chemical Sciences, Indian Association for the Cultivation of Science (IACS), Kolkata. He superannuated as Professor and Head of the Department of Medicinal Chemistry from NIPER in August 2019 and thereafter was Visiting Professor in the Department of Chemistry, IIT Ropar, Punjab, before joining IACS as Emeritus Fellow.

Prof. Chakraborti obtained an M.Sc. degree in Organic Chemistry from the University of Burdwan, Burdwan, West Bengal, India, in 1977 being placed first in the first class and a Ph.D. degree in Synthetic Organic Chemistry from IACS, Kolkata, India, in 1985.

He received post-doctoral research training in the Department of Chemistry, Clemson University, South Carolina, USA, during 1985–1987 and in Medicinal Chemistry at Purdue University, West Lafayette, Indiana, USA, during 1987–1989. After that he joined the Department of Chemistry at Burdwan University as a faculty in January 1990. He moved to the Department of Medicinal Chemistry at NIPER as Assistant Professor in November 1994, was elevated to Associate Professor in 1999 and Professor and Head in 2001. He has also been the Dean of NIPER.

Prof. Chakraborti has guided 41 Ph.D. and 130 Master's students, published 181 research papers with >12,000 citations with an *h* index of 65. He filed 42 patents of which 27 have been granted. He is among the top 2% Indian scientists (in the field of Organic Chemistry) in the World Ranking 2022 (Indian rank: 25; world rank: 1,326) and is one of the Top Chemistry Scientists 2022 (world rank: 3,713; national rank 31).

His research interest in Organic Chemistry involved the development of new synthetic methodologies (transition-metal-based catalysis and organo-catalysis, C–H activation, etc.) in compliance with the green chemistry principles and deriving novel concepts (such as understanding the molecular-level role of acceleration of organic reactions in water and fluorous alcohols, the origin of the organo-catalytic potential of ionic liquids, etc.); development of green or sustainable chemistry for greener synthetic routes to bioactive natural products, cardiovascular drugs, and other biologically active molecules; and development of methodologies for solid/solution phase synthesis of small molecular libraries.

He is also a passionate medicinal chemist having focus on the target-based design and synthesis of new chemical entities in various therapeutic areas of tropical communicable and neglected diseases like tuberculosis, leishmaniasis; non-communicable diseases like inflammation, rheumatoid arthritis, asthma, and COPD; and diabetes.

Prof. Chakraborti has received several awards and recognition such as University Gold Medal, Bardhaman Sammilani Gold Medal, ISMAS Eminent Mass-Spectroscopist Award, Ranbaxy Research Award (Pharmaceutical Sciences), Chemical Research Society of India Silver and Bronze Medals, Indian Chemical Society's Professor P. K. Bose Memorial Award 2019, and Dr. Nitya Anand Endowment Lecture 2021 of INSA. He also received the Rajnibhai V. Patel PharmInnova Best Research Guide Awards for the most "innovative Ph.D. thesis" during 2017–2018 and 2016–2017, and the most "innovative MS thesis" during 2015–2016 and 2014–2015 in "pharmaceutical chemistry"; Certificate of Appreciation for Ph.D. Thesis Advisor of Eli Lilly and Company Asia Outstanding Thesis First Prize Awardee in 2013, 2012, and 2009 and Second Prize Award in 2009. He is Fellow of the Royal Society of Chemistry, has been elected Life Fellow of the Indian Chemical Society, Fellow of Indian Academy of Sciences, Bangalore, and Fellow of Indian National Science Academy, New Delhi.