Foreword

I am very happy to participate in this labour of love, and to write this foreword. It was a surprise to learn that Professor Subrata Ray has reached the Festschrift age. He has been, and is, a very lively and active figure in the growth of quality materials science at Roorkee. He has influenced the field widely in India through his students and many collaborations. As a professional and as a person, he has affected positively a large number of people. Unusually among scientists and technologists, his interests and work extend well beyond materials science. In this age of specialization, where high quality professionalism in a narrow field is what one expects at most from practitioners, Professor Ray is an exception; he is that and more, but first, his serious contributions are not in a single area of 'specialization' in metallurgy; then they extend into materials which are not metallic. A wider circle is that of his initial professional interests; namely electron physics. Indeed, his first published paper, and his PhD research work, are both in this field. There are his human qualities and strong commitments to justice as well as to professional quality. All of these are integrated into a personality that is warm, insightful, practical and directed clearly without being abrasive. His colleagues, admirers and friends have brought out this volume which partially expresses this regard; there cannot be a volume which does full justice to the professional and personal work and impact of Professor Subrata Ray.

Professor Ray's first love namely his work in the area of ceramic light metal microcomposites formed by the stir casting route, which is both scientifically pioneering and technologically appropriate, is represented by a few contributions. There are several articles on nanocomposites, an area of intense contemporary research. There are contributions on anode materials formed in a new way for Li ion batteries, reviews of electroless coatings and Ni-Co nanocomposites. These give a glimpse of what Professor Ray, in a lifetime of academic research and innovation has accomplished, and the school he has set up at Roorkee. It is easy to curse the academic and societal darkness. Professor Ray has lit many lamps which have dispelled it. It is not appreciated that research applied to technology is specially difficult, in India. Unlike speculative research, you have to be right and affordable. The industry has to be receptive, and to have the right capabilities. There is the gigantic 'military industrial complex' out there which is not exactly welcoming; it may ignore you or take the best and give it a different spin. Given this, it is admirable that hardy, positive spirited academics like Professor Ray continue. The articles in this volume give ample evidence that his spirit is infectious.

Perhaps the most attractive article in this book is that by Professor Ray in which he looks back at his personal and professional journey. His strength which flows from his beginnings and his personality, comes through. His attractive personal traits of passion for justice, fearlessness, intellectual curiosity and freedom, his warmth and uncommon commonsense, all are apparent. His varied contributions to metallurgy and materials science are briefly touched upon, their origin and development described.

As the PhD mentor of Professor Ray, whose most vivid memory of him is of this unusual metallurgy student who actually wanted to do research on cohesion in alloys, a hardy perennial, I particularly rejoice at this outpouring from fellow professionals.

T V Ramakrishnan, FRS
Emeritus Professor, Banaras Hindu University, Varanasi
Distinguished Associate, Centre for Condensed Matter Theory
Indian Institute of Science, Bangalore
Distinguished Visiting Professor, NCBS-TIFR

Preface

I first met Professor Subrata Ray at the annual MRSI Conference held at IIT Kharagpur in February 1994. I was just another impressionable PhD scholar from IIT Kanpur who had come to present a poster on his "rather novel" work on pressureless infiltration processing of Al/AlN composite. For my research work I was in need of magnesium and my supervisor, the Late Professor V.S.R. Murthy, pointed out Professor Ray to me in the gathering and asked me to meet him with my request. I met Professor Ray during a session break and explained to him as to how I could incorporate more than 50% by volume of SiC or Al_2O_3 as reinforcement in an aluminium matrix and substantially improve the strength and modulus of the metal matrix composite without compromising the fracture toughness. He gave a patient hearing and promised to send me the material, which to my great relief, arrived shortly after in my lab free of cost. At that time it never occurred to me that Professor Ray would be my colleague ten years hence. Time has passed quickly and there is much to reflect upon and celebrate in the professional accomplishments of Professor Ray during his association with the Indian Institute of Technology Roorkee (the erstwhile University of Roorkee).

Materials Science and Engineering at its core is an interdisciplinary subject which embodies fundamental knowledge from the great disciplines of Science and Engineering. Professor Ray cut his teeth in research at IIT Kanpur by attempting to tackle grandiose materials problems involving quantum mechanics and alloy theory in his formative years. The skill he gained has instilled in him the confidence to make indelible contributions in several fields including Composite and multiphase materials, Metal Physics, Amorphous alloy coatings, Alloy processing and properties, and more recently Energy materials. The students he supervised in these disciplines stand testimony to the training he imparted, with a few of them even serving as faculty members in various IITs and IISc.

There is so much a young academician can learn from Professor Ray, who is a conscientious teacher, meticulous researcher and a very able administrator. His friendly demeanour and vast knowledge developed by constant retooling is a great draw among his wide circle of contacts and anyone who needs a particular advice. In April 2012 a few of us planned a weekend getaway in Mussoorie with Professor Ray and enjoyed the privilege of dissecting several issues relating to us personally, the environment where we live and work, and issues facing the nation for two whole days. It was definitely an enchanting experience that we will carry in our memories for a long time.

This Festschift is brought out to honour Professor Ray on his sixty-fifth birthday for his significant contribution to materials development. The collection of invited papers by his colleagues, past students and collaborators which make up this volume reflect the varied interests of the man himself. It has been a privilege for me to coordinate this effort which was made easy by the cooperation from the contributing authors. A special word of thanks is due to Mr. Thomas Wohlbier, Director, Trans Tech Publications for coming forward to publish this special volume in Materials Science Forum.

The contribution of Professor Ray in the thirty-four years he served in the Institute is endless. As Head of the Department, Dean (Administration) and Dean (Sponsored Research & Industrial Consultancy) he set an example of administrative probity. Suffice to say that the energy he brought into any activity (be it curriculum development or FIST proposal presentation or BTech project coordination to name a few) leading by setting an example was contagious. In his leaving the Institute has lost a visionary and the Department a tireless champion furthering its cause. Professor Ray has always maintained that he looks forward to retirement to pursue his dreams. He has definitely earned that right, and I along with all the contributing authors wish him health and happiness to pursue challenges and opportunities that come his way, to influence engineering education for the better in our great nation.

B.S.S. Daniel
Metallurgical and Materials Engineering
Indian Institute of Technology Roorkee

Professor Subrata Ray

Professor Ray obtained his Bachelor's degree from Bengal Engineering College, Shibpur and Gold Medal from Calcutta University for standing first in his discipline. He was awarded M.Tech and Ph.D. degree by IIT Kanpur. He joined a career in research and worked in National Aeronautical Laboratory, Bangalore and National Physical Laboratory, Delhi, before joining the erstwhile University of Roorkee in 1978 as a faculty in Metallurgical and Materials Engineering. He has held visiting appointments in the University of Wisconsin – Milwaukee, USA, Institut National Polytechniq de Grenoble, France and Technical University, Berlin, Germany. He has research interests in Materials development with special emphasis on cast metal matrix composites (MMC). He has many pioneering contribution in cast MMC including introduction of stir-casting and addition of surface active elements for which he held the first patent in the world. Since then, Professor Ray has progressively decreased the size of reinforcement in stir-cast composite from hundreds of microns to nanometers. In the mean time he also developed interest on materials used in Li-ion batteries. He has supervised twenty nine M. Tech dissertations and thirty four dissertations leading to Ph.D. degree. He has published more than 200 technical papers, mostly in International journals and handbooks including those of ASM and ASLE. For his research contribution, Professor Ray has received MRSI annual, Medal and Khosla Research Medal. He is a fellow of the National academy of Sciences, India and Indian National Academy of Engineering. Professor Ray has extensive experience in administration of academic institute in various capacities including the Head of academic department, Chairman, Gate, the Dean, Administration and the Dean, Sponsored Research and Industrial Consultancy (SRIC). He is currently visiting distinguished professor at IIT Mandi and also, a member of its BOG. His objective is to promote clean and principled academic life in pursuit of knowledge without fear and favour.