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Editors

Pollutants from Energy Sources

Characterization and Control

Springer

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Preface

Energy demand has been rising remarkably due to increasing population and urbanization. Global economy and society are significantly dependent on the energy availability because it touches every facet of human life and activities. Transportation and power generation are two major examples. Without the transportation by millions of personalized and mass transport vehicles and availability of 24×7 power, human civilization would not have reached contemporary living standards.

The International Society for Energy, Environment and Sustainability (ISEES) was founded at Indian Institute of Technology Kanpur (IIT Kanpur), India in January 2014 with an aim to spread knowledge/awareness and catalyse research activities in the fields of Energy, Environment, Sustainability and Combustion. The Society's goal is to contribute to the development of clean, affordable and secure energy resources and a sustainable environment for the society and to spread knowledge in the above-mentioned areas and create awareness about the environmental challenges, which the world is facing today. The unique way adopted by the society was to break the conventional silos of specialications (Engineering, science, environment, agriculture, biotechnology, materials, fuels etc.) to tackle the problems related to enegy, environment and sustainability in a holistic manner. This is quite evident by the participation of experts from all fields to resolve these issues. The ISEES is involved in various activities such as conducting workshops, seminars, conferences, etc. in the domains of its interests. The society also recognizes the outstanding works done by the young scientists and engineers for their contributions in these fields by conferring them awards under various categories.

Second International Conference on 'Sustainable Energy and Environmental Challenges' (SEEC-2018) was organized under the auspices of ISEES from December 31st 2017–January 3rd, 2018 at J N Tata Auditorium, Indian Institute of Science Bangalore. This conference provided a platform for discussions between eminent scientists and engineers from various countries including India, USA, South Korea, Norway, Finland, Malaysia, Austria, Saudi Arabia and Australia. In this conference, eminent speakers from all over the world presented their views related to different aspects of energy, combustion, emissions and alternative energy

resource for sustainable development and cleaner environment. The conference presented 5 high voltage plenary talks from globally renowned experts on topical themes namely "Is It Really the End of Combustion Engines and Petroleum?" by Prof. Gautam Kalghatgi, Saudi Aramco; "Energy Sustainability in India: Challenges and Opportunities", by Prof. Baldev Raj, NIAS Bangalore; "Methanol Economy: An Option for Sustainable Energy and Environmental Challenges", by Dr. Vijay Kumar Saraswat, Hon. Member (S&T) NITI Ayog, Government of India; "Suprcirtical Carbon Dioxide Brayton Cycle for Power Generation" by Prof. Pradip Dutta, IISc Bangalore and "Role of Nuclear Fusion for Environmental Sustainability of Energy in Future" by Prof. J. S. Rao, Altair Engineering.

The conference included 27 technical sessions on topics related to energy and environmental sustainability including five plenary talks, 40 keynote talks, and 18 invited talks from prominent scientists, in addition to 142 contributed talks, and 74 poster presentation by students and researchers. The technical sessions in the conference included Advances in IC Engines: SI Engines, Solar Energy: Storage, Fundamentals of Combustion, Environmental Protection and Sustainability, Environmental Biotechnology, Coal and Biomass Combustion/Gasification, Air Pollution and Control, Biomass to Fuels/Chemicals: Clean Fuels, Advances in I.C. Engines: CI Engines, Solar Energy: Performance, Biomass to Fuels/Chemicals: Production, Advances in I.C. Engines: Fuels, Energy Sustainability, Environmental Biotechnology, Atomization and Sprays, Combustion/Gas Turbines/Fluid Flow/Sprays, Biomass to Fuels/Chemicals, Advances in I.C. Engines: New Concepts, Energy Sustainability, Waste-to-Wealth, Conventional and Alternate Fuels, Solar Energy, Waste Water Remediation and Air Pollution. One of the highlights of the conference was the Rapid Fire Poster Sessions in (i) Energy Engineering, (ii) Environment and Sustainability, and (III) Biotechnology, where more than 75 students participated with great enthusiasm and won many prizes in a fiercely competitive environment. 200+ participants and speakers attended this four days conference, which also hosting Dr. Vijay Kumar Saraswat, Hon. Member (S&T) NITI Ayog, Government of India as the chief guest for the book release ceremony, where 16 ISEES books published by Springer, under a special dedicated series "Energy, Environment and Sustainability" were released. This was the first time that such significant and high quality outcome has been achieved by any society in India. The conference concluded with a panel discussion on "Challenges, Opportunities & Directions for Future Transportation Systems", where the panelists were Prof. Gautam Kalghatgi, Saudi Aramco; Dr. Ravi Prashanth, Caterpillar Inc.; Dr. Shankar Venugopal, Mahindra and Mahindra; and Dr. Bharat Bhargagava, DG, ONGC Energy Center, and Dr. Umamaheshwar, GE Transportation, Bangalore. The panel discussion was moderated by Prof. Ashok Pandey, Chairman, ISEES. This conference laid out the roadmap for technology development, opportunities and challnges in Energy, Environment and Sustainability domain. All these topic are very relevant for the country and the world in present context. We acknowledge the support received from various funding agencies and organizations for the successful conduct of the Second ISEES conference SEEC-2018, where these books germinated. We would therefore like to acknowledge SERB, Government of

India (Special thanks to Dr. Rajeev Sharma, Secretary); ONGC Energy Center (Special thanks to Dr. Bharat Bhargava), TAFE (Special thanks to Sh. Anadrao Patil), Caterpillar (Special thanks to Dr Ravi Prashanth), Progress Rail, TSI, India (Special thanks to Dr. Deepak Sharma); Tesscorn, India (Special thanks to Sh. Satyanarayana); GAIL, VOLVO, and our publishing partner Springer (Special thanks to Swati Meherishi).

The editors would like to express their sincere gratitude to large number of authors from all over the world for submitting their high quality work in a timely manner and revising it appropriately at a short notice. We would like express our special thanks to Dr. Tapan Kumar Pradhan, Dr. Atul Dhar, Dr. Akhilendra Pratap Singh, Dr. Ludovica Luise, Dr. Joonsik Hwang, Dr. Chetan Patel, Dr. Pravesh Chandra Shukla, Dr. Sundeep Singh, Dr. Rohit Singla, Dr. Rajesh Prasad, Dr. Vikram Kumar, Dr. Dev Prakash Satsangi, Dr. Anoop Kumar Shukla, Mr. Maneesh Kumar, Mr. Neeraj Sharma, Mr. Sunil Kumar, Mr. Yeshudas Jiotode, Mr. Pawan Kumar, who reviewed various chapters of this book and provided very valuable suggestions to the authors to improve their manuscript.

The book covers different aspects of Energy consumption, environmental pollution and progress of a country is dependent on such aspects. This book is relevant for engineers, agriculturists, environmentalists, ecologists, governmental individuals, policy makers involved in area of pollutants from energy sources, environmental safety, and health issues. The book language is easy to understand, comprehensive in diagnostic techniques and may continue to serve well to students working in the field of energy and sustainability. The effective utilization of high-grade energy through thermochemical conversion of different wastes is discussed in this book. The methods and techniques to extract energy from e-wastes and biomass and their optimization can surely support the energy sector and satisfy a part of energy demand.

Kanpur, India

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Contents

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Avinash Kumar Agarwal is a Professor in the Department of Mechanical Engineering in Indian Institute of Technology Kanpur. His areas of interest are IC engines, combustion, alternative fuels, conventional fuels, optical diagnostics, laser ignition, HCCI, emission and particulate control, and large bore engines. He has published 24 books and 230+ international journal and conference papers. Professor Agarwal is a Fellow of SAE (2012), ASME (2013), ISEES (2015) and INAE (2015). He received several awards such as Prestigious Shanti Swarup Bhatnagar Award—2016 in Engineering Sciences, Rajib Goyal

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Dr. Tarun Gupta Professor and PK Kelkar Research Fellow at the Department of Civil Engineering, IIT Kanpur, India. He holds a Doctor of Science (2004) in Environmental Health, Harvard University (USA) and Master of Technology (2000), Environmental Science and Engineering, Indian Institute of Technology Bombay (9-month research stay at the TU Dresden, Germany). He has published more than 95 articles in ISI indexed journals, 4 book chapters, and filed 4 Indian patents. A submicron aerosol sampler designed, developed and evaluated at the IIT Kanpur has since been commercialized by Envirotech (Delhi). He has developed several low-flow-rate and high-flow-rate impaction-based samplers and a non-selective membrane-based diffusion denuder. He is a member of INYAS (2016), PK Kelkar Research Fellowship (2015), NASI Scopus Young Scientist (2015), INSA Young Scientist (2011), INAE Young Engineer (2009), and IEI Young Engineer (2008).

Nikhil Sharma is a scientist in the Engine Research Laboratory in IIT Kanpur, India. He received his M.Tech. in Mechanical Engineering from NIT Hamirpur, India in 2012. and his Ph.D. from IIT Kanpur, in 2017. He was an assistant professor at Amity University's Department of Mechanical and Automation Engineering, Noida. His areas of research include alternative fuels for IC engines (biodiesel, alcohols), emission control and particulate characterisation.

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