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Book review
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Fundamentals of Materials for Energy and Environmental Sustainability

David S. Ginley and David Cahen, Cambridge University Press, New York, NY, USA, 2012, ISBN 978-1-107-00023-0, $105·0, 753 pp

With the increasing demand for alternative energy systems, the push for investment in industry and academic sectors in this area is significant. As for academia, it is vital that educational investment is given as much attention as research investment. This would ensure well-trained and knowledgeable workforce in the area of alternative energy without which the investments will not yield much benefit. With this as a motivation, academicians are increasingly focusing on educational federal grants and the departments are encouraging faculty to teach courses in energy. In particular, materials science departments are focusing on the teaching of energy materials and technology. Thus, there is a need for a comprehensive text book that can serve as an information source or handbook for energy materials. However, this remains a challenge due to the fast pace of the field of alternative energy and changing global dynamics as well as socioeconomic conditions. In addition, it is hard to determine which area of alternative energy is of greater importance. For example, increasing struggle for solar cell efficiency enhancement, water-splitting catalysts have been a challenge with regard to discovery and efficiency, replacement of rare earths in energy storage devices is far from fully realized and bulk energy strategies (nuclear, wind, hydro and biomass) are geographically segregated and limited by unavailability of resources.

As an instructor teaching an undergraduate course, it was difficult for me to find a complete book, which I could use as a text book and which could satisfy me as an instructor. I was recommended this book by one of the experts in the field. The authors David S. Ginley and David Cahen (*Fundamentals of Materials for Energy and Environmental Sustainability*) have put together a fantastic piece of work in this edition, which is divided into six parts: (*a*) energy and environmental impact, (*b*) nonrenewable energy sources, (*c*) renewable energy sources, (*d*) energy transportation, (*e*) energy efficiency and (*f*) energy storage and grid. Using this as a text book in the classroom comprising of an interdisciplinary group of students, both at graduate and undergraduate levels, provided me with an excellent resource for developing a new energy course in my department. Overall, the book is a compilation of innovative writing and research by various well-known authors in this field. I found the book to be well written, covering various aspects of energy materials and starting with emphasizing the motivational factors behind alternative energy, such as environmental damage due to the use of fossil fuels. The first part of the book includes chapters emphasizing on climate change, global energy landscape and security, sustainability, energy material costs, economics, global energy/materials flows and greenhouse gas emissions. This motivational section leads into nonrenewable energy sources such as petroleum, natural gas, coal conversion technologies, oil and gas, unconventional energy sources such as gas hydrates, nuclear energy and nuclear issues. Part three focuses on renewables and discusses solar energy harvesting technologies, concentrating solar thermal power, thermoelectrics, biofuels, photocatalysis, geothermal and ocean energy, and wind energy. The book also delves into issues of energy transportation and efficiency in part four and five of the book. Here, understanding of motor vehicles, shipping and aviation aspects of energy are discussed. The efficiency section relates to lighting, civil engineering, green processing and recycling of materials aspects. Finally, the sixth part of the book deals with smart grid goals, high-penetration renewables, batteries and capacitors, mechanical energy storage systems, fuel cells, solar fuels and hybrid solar conversion methods. In terms of topics, this book is one of the most comprehensive texts in the area of energy materials. However, technical in-depth discussions can be improved and made stronger and could have made this book a complete resource in itself. Having said this, one should not underestimate the strengths of this text book as it is the perfect book to start with in a classroom. The text is appropriate for undergraduate readings. Furthermore, by supplementing fundamentals and technical aspects of this area via classroom discussions makes it a great teaching and learning experience. As a beginner researcher in the field of energy, this book provides a thorough discussion on various aspects of energy. Undergraduates find it easy to read and enjoy the discussions and details. However, for graduate students, it may be less intense in terms of mathematical formulation of energy concepts. As an instructor, I feel that various levels of challenges in the energy materials class emerge with diverse difficulty level of students and how they consider impactful learning in this area. The book reviewed here does a fantastic job of providing us with a comprehensive overview of energy issues, technologies and accomplishments. I would suggest that if you are developing a new course in this area at graduate or undergraduate level, want to learn about energy technologies or motivate a young professional or graduate student beginning in this area of research, consider this book.

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