

Preface

With our growing energy needs and increasing environmental concern, there is considerable research interest in developing renewable energy sources as alternatives to the non-renewable fossil fuels as well as improving the technologies for energy conversion.

Solar energy is an inexhaustible and freely available energy source. More energy comes from the sun in 1 hr each day than is used by all humankind activities in one year. The challenge today is to capture and utilize solar energy for sustainable development on a grand scale. There are different manifestations of solar energy conversion, of which one relies fundamentally on chemistry for its scientific underpinnings, i.e., the conversion of light into electricity. Photovoltaic devices are available for decades for the direct conversion of sunlight into electrical energy. The technological promise of the characteristics of OLEDs puts them at the forefront of research in the past two decades. OLEDs possess a number of advantages over conventional dominant display devices, such as high luminous efficiency, high brightness and contrast, fast response time, wide viewing angle, low power consumption and light weight. These new technologies offer a virtually unlimited choice of colors and good potential of low manufacturing cost. While OLED displays can be fabricated on large area and flexible substrates, a stream of new OLED products has reached the marketplace. Therefore, the transformations of light into electricity (solar energy conversion) and electricity into light (light generation in light-emitting diode) are two important interrelated areas in energy conversion. Organometallic molecules and related compounds hold great promise as versatile functional materials for use in these light-electricity transformations.

In addition, development of new molecular systems for converting carbon dioxide to useful chemicals using solar light, i.e., photocatalytic CO₂ reduction systems, is gaining increasing attention for solving the energy shortage and global warming problems. Hydrogen has also attracted great interest because of its potential to serve as an energy storage medium, i.e., an energy carrier. There is great interest in using metal complexes to store hydrogen at higher densities and metal-based catalysts will certainly play major roles in its safe and efficient production and utilization.

As the research fields on energy conversion are growing rapidly and their impacts are both far-reaching and pervasive, other fundamental challenges still remain which would require further multidisciplinary studies. Therefore, to bring a focus on the recent research developments in this direction, a collection of chapters from leading scientists is presented in this book. Many aspects of the field by utilizing a vast number of organometallics and related molecules and their device tactics are covered, which provide readers with a good source of information in solving many of the critical issues on energy conversion. These include the investigation of new light-harvesting and OLED materials (by J.A. Gareth Williams, Etienne Baranoff, Tao Chen, Tsuyoshi Michinobu, Qiang Zhao, Jianzhang Zhao, Suning Wang, Di Liu, Zhen-Tao Yu and Shi-Jian Su), the studies on carbon dioxide reduction (by Shunichi Fukuzumi) and water oxidation (by Khurram Saleem Joya, Kwok-Yin Wong, Luca Gonsalvi, Qiang Xu and Torsten Beweries) as well as other related topics (Toshikazu Hirao and myself).

Clearly, the challenge confronting the twenty-first century is tied to energy crisis and it is encouraging to see that organometallic compounds and related materials are playing important roles in these frontier areas. What organometallic materials can do to address this challenge will have significant impacts on our society, and we are optimistic to witness more successful stories to come in the upcoming future.

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<http://www.springer.com/978-3-662-46053-5>

Organometallics and Related Molecules for Energy
Conversion

Wong, W.-Y. (Ed.)

2015, XIII, 537 p. 378 illus., 125 illus. in color.,

Hardcover

ISBN: 978-3-662-46053-5