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《光电化学及新型太阳能电池》专辑序言

——新型太阳能电池:未来绿色可再生能源的最大希望

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众所周知, 能源与环境是当今人类面临的重大难题和挑战, 随着世界能源需求的急剧攀升, 传统化石资源的不断耗竭, 全球温室效应和环境污染的压力日趋严重, 发展各种可再生绿色能源成为当今世界最主要的共性问题 and 研究热点. 太阳能光电转化技术被认为是一种最有希望真正解决未来社会可再生能源和洁净环境问题的先进技术. 太阳可为人类提供取之不尽、用之不竭的巨大能源宝库, 每年照射到地球的太阳能量高达 174000 TW, 换言之, 只要能以 10% 效率转化 0.1% 到达地球表面的太阳能, 即可满足全球的能源需求.

当前国际上最热点研究的新型太阳能电池包括染料敏化太阳能电池、有机太阳能电池、量子点太阳能电池及钙钛矿太阳能电池等, 这些新型太阳能电池的研究近年来取得了长足的进步, 世界上每年发表相关论文超过 10000 篇, 其中中国学者在太阳能光电化学理论、光电转化器件设计、电极材料、有机半导体光伏材料、电解质系统、有机及钙钛矿太阳能电池电极界面修饰层材料等方面开展了大量卓有特色的工作, 为推进各种新型太阳能电池的进步和应用做出不菲的贡献.

光电化学是一门研究光与电相互作用的交叉学科, 是太阳能高效利用中光-电转化和光能-化学能转化的核心理论基础. 自上世纪 70 年代以来, 光电化学理论得到不断发展和完善, 为当今蓬勃发展的各种新型太阳能电池和光催化制氢等提供了强有力的理论指导. 然而, 随着纳米科技、材料科学及半导体物理等现代科技的飞速发展和多学科深入研究, 诸多新型太阳能体系研究的新现象和复杂性仍未能得到圆满解析. 仍亟需进一步从微观水平认识太阳能电化学电池及光电催化的反应本质, 发展原位表征和超快时间分辨技术研究光生电子的传输、复合及界面反应等规律及定量关系, 为人们设计高光电转化效率的电化学太阳能电池、推进商品化应用提供理论指导.

本专辑围绕光电化学及新型太阳能电池专题, 收录了在相关研究领域具有丰富积累和影响的团队所撰写的 9 篇相关研究进展的综述文章和研究论文, 部分反映了我国在新型太阳能电池结构设计、合成方法和性能研究方面的研究进展. 希望借助该专刊的出版, 能使广大读者更深入地了解我国在新型太阳能电池领域的研究现状、研究趋势和存在的问题及挑战, 推动我国光电化学及新型太阳能电池研究的进一步发展.

在此, 对本专辑的所有作者、审稿人及编辑部工作人员的卓有成效的工作和付出表示衷心的感谢!

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Special Issue: Photoelectrochemistry and New Types of Solar Cells Future Green Renewable Energy Resources

Human society has been facing a global energy problem and gigantic challenge, due to the continually increasing energy demand to support economic growth, the gradual depletion of fossil fuels, and the greenhouse effect caused by fossil fuel combustion. Promoted development of various renewable energies becomes one of the most common issues and hot topics in the world. Photovoltaic technology is most attractive and has been fastest developing as a green and renewable energy in solar applications. The Sun shines on the Earth, thus providing around 3×10^{24} J of green energy per year, if covering only around 0.1% of the Earth's surface by means of energy conversion devices with efficiency of about 10% would satisfy the present global energy needs.

Nowadays, because of the low cost and friendly environment impact, the third generation of photovoltaic systems, including dye-sensitized solar cells (DSSCs), organic solar cells (OSCs), quantum dots solar cells (QD-SCs), and perovskite solar cells (pero-SCs), have been most extensively studied. Remarkable progresses have been achieved with more than 10,000 publications per year in the field in the past years. Obviously, the solar energy will be continually encouraging people to make even greater efforts towards the direction of improving solar energy conversion efficiency and realizing commercialization. Meanwhile, Chinese scientists have made significant contributions to photoelectrochemistry, design of photovoltaic devices, electrode materials, photovoltaic materials, electrolytes, electrode buffer layer materials for organic and perovskite solar cells.

Photoelectrochemistry is a cross-branch research field of photochemistry, photophysics and electrochemistry. It plays a core and fundamental role in conversions of photo energy to electricity and photo to chemical energy in the applications of solar energy. Since 70s' in the last century, photoelectrochemistry had been well developed. It provides fundamental direction to nowadays blooming developments in various new types of solar cells and photoelectrocatalytic hydrogen production as well. However, as the multidisciplinary studies of nanotechnology, materials science and semiconductor physics, many questions remain unsolved and complexity of the new types of solar cells needs to be further addressed. In order to better understand the optoelectronic conversion mechanism for improving photovoltaic performance and promoting application of the new types of solar cells, it is necessary to further develop in-situ and extra-fast spectroscopic analyses, and other state-of-the-art techniques to elucidate the transportation and recombination of photogenerated electrons and relevant interfacial reactions in the cell systems.

In this special issue, we collect 9 submissions including review and research articles from some leading research groups in photoelectrochemistry and new types of solar cells in China, to attract more researchers to focus their studies on this blooming field. We would like to take this opportunity to thank all the authors, reviewers, and editorial staffs of Journal of Electrochemistry for their excellent and professional contributions to this special issue.

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