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Preface to Special Issue on Water Electrolysis for Hydrogen Production

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《电解水制氢》专辑序言

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在全球能源危机、环境危机以及国际形势复杂的大背景下, 氢能成为全球能源转型发展的重要载体, 氢能产业成为战略性新兴产业, 是未来产业不可或缺的重点发展方向。可再生能源驱动的电解水制取绿氢技术则是氢能战略性新兴产业竞争的焦点。在“双碳”背景下, 我国急需抓住氢能产业的发展机遇, 大力发展电解水制氢技术, 推动相关装备与产业的发展, 提升我国电解水制氢技术国际竞争力。

电解水制氢有多种途径, 包括碱水制氢、质子交换膜电解水、阴离子交换膜电解水和固体氧化物电解水等。尽管各个体系目前所处发展阶段不同, 如碱水制氢已实现初步商业化, 质子交换膜电解水制氢尚在商业化示范阶段, 但若要实现电解水大规模产业化应用, 仍面临着降低成本和电能消耗与提高耐久性等巨大挑战。从产业发展角度分析, 只能通过技术革新, 包括关键材料如电极和隔膜等性能突破、核心部件的研发以及系统集成与控制优化等, 才能平衡制氢规模、设备成本、使用寿命和能耗之间的制衡关系。这些挑战背后仍存在诸多科学、技术和工程问题尚待研究工作者逐一突破。

本专辑收录了在电解水制氢领域具有丰富研究经验团队撰写的 12 篇论文, 包括 1 篇观点论文、6 篇综述论文和 5 篇研究论文, 分为上下两期出版。专辑涉及碱水制氢、海水制氢、阴离子交换膜电解水制氢与质子交换膜电极水制氢等体系, 覆盖电解水制氢面临的关键科学与技术问题, 从多个角度部分展示了我国电解水制氢技术的最新进展、现存的问题与挑战、解决策略与思路, 以及未来的发展方向与研究趋势等。希望借此专辑, 能为读者了解和深入开展电解水制氢领域的研究提供参考, 以期为推动我国电解水制氢技术的进一步发展尽绵薄之力。

在此, 对本专辑撰稿的作者给予的支持与贡献表示衷心的感谢! 对审稿人及编辑部工作人员的辛勤劳动和付出表示诚挚的谢意!

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Preface to Special Issue on Water Electrolysis for Hydrogen Production

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In response to the global energy crisis, environmental crisis, and complicated international situation, hydrogen energy has become an important carrier for global energy transformation and development and the hydrogen industry has grown into a strategic emerging industry, representing a key development direction for future industries. The hydrogen production with zero carbon emission via water electrolysis powered by renewable energies is thus emerging as a competitive and eye-catching technique in the strategic emerging hydrogen industry. To achieve the goal of carbon peaking and carbon neutrality, China urgently needs to embrace the opportunities and challenges in the development of hydrogen industry to vigorously advance water electrolysis technology, promote the development of related equipment and industries, and enhance our international competitiveness in the field.

Several water electrolysis systems can be used to produce green hydrogen, including alkaline water electrolysis, proton exchange membrane water electrolysis, anion exchange membrane water electrolysis, and solid oxide water electrolysis. Although these techniques are stepping into the different stages towards commercialization, such as the early-stage commercialization for alkaline water electrolysis and the commercial pilot stage for proton exchange membrane water electrolysis, the large-scale industrial application of water electrolysis is still facing the challenges of reducing cost and electricity consumption, improving electrolyzer durability, etc. From the perspective of industrial development, the technological innovations, including advancements in the performance of key materials like electrodes and membranes, research and development of essential components, and integration and control of equipment, are necessary to achieve the balance among the scale of hydrogen production, equipment lifetime, and energy consumption (cost). Behind these challenges, there are still lots of scientific, technical, and engineering issues that need to be solved by researchers.

Focusing on water electrolysis for hydrogen production, this special issue contains 12 papers written by teams rich in experience in related research fields, including one perspective paper, six review papers, and five research papers. It covers the scientific and technical problems faced by water electrolysis, including alkaline water electrolysis, seawater electrolysis, anion exchange membrane water electrolysis, and proton exchange membrane water electrolysis. It presents the latest research progress, the existing problems and challenges, the strategies and ideas, as well as the future development directions and research trends from several perspectives. Hopefully, this special issue will provide readers with knowledge and references they need to understand and conduct in-depth research in the subject for the further development of water electrolysis for hydrogen production in China.

With this preface, we would like to take the opportunity to thank all the authors for their contributions and outstanding support for the special issue and acknowledge the editorial team and all of the reviewers for their fruitful work and dedication in helping to publish this special issue.