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“电化学前沿”专辑序言

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电化学是一门历史悠久但充满活力的学科,自 1791 年 Galvani 发现动物电现象,电化学经历了多次蓬勃发展与变革拓展。电化学是研究与电有关的物质转化和能量转化及其规律的学科,是横跨自然科学(理学)和应用科学(工程、技术)两大领域的重要学科。传统观念认为电化学主要研究电能和化学能之间的相互转换,如电解和电池。但电化学并不局限于与电能相关的化学反应,也包含其它物理化学过程,如电化学生物传感、光电化学、金属电镀与腐蚀等。随着时代进步,各种新兴技术如光谱、质谱、显微、计算模拟等也被应用于电化学体系和过程研究。

当前,随着清洁能源的需求与日俱增,双碳目标提上日程,在新能源汽车、可再生能源、绿色工业合成等领域的国家的重大需求日益迫切,电化学学科迎来第三个黄金发展期。同时,电化学与能源、材料、环境、信息、生物医学等学科不断交叉融合,深入发展,人才队伍也在不断壮大,众多学科人才不断进入电化学领域,近十年全国电化学年会参会人数呈现指数增长,2019 年第 20 次全国电化学会实际参会人数突破五千人。

近十多年来,在基础电化学和应用电化学领域都展现出了很多新的前沿热点研究方向。在电化学基础研究中,理论处理和实验方法已处于突破的节点,在可预期的将来会有重要发展。电催化近年来与材料科学深度结合,在燃料电池技术应用需求的驱动下发展迅速。随着太阳能等绿色可再生能源需求的不断增加,光电化学等应用于太阳能转化的实用技术如基于钙钛矿太阳能电池的研究成为一大热点。新能源汽车的万亿产业链已经在全世界铺展开来,能源存储与转换也将是未来一段时间的重点方向,将在环境和经济领域发挥举足轻重的作用。随着脑机接口与元宇宙等新技术与新概念的出现,未来微电路芯片与生物电化学的结合也将会是下一次技术革命的发展方向。

电化学前沿专辑(2022 年 2 月和 3 月分两期印刷)将刊登系列综述和研究论文,涉及前沿实验技术及理论研究方法,包括同步辐射表征技术、电化学伏安及计时电流法、磁共振在金属离子电池中的应用、电输运谱在原位电化学界面测量应用、单纳米颗粒电化学测量技术、穆斯堡尔谱技术在电催化中的应用、电化学双电层建模、基于机器学习的原子模拟在电化学方面的应用;同时,脑神经电化学研究、各种原位技术在氧还原研究中的应用、电催化材料开发及燃料电池以及储能二次电池的研究进展等也将在专辑中详细介绍。

让我们共同努力推动电化学学科发展,使蓬勃发展的电化学为社会重大需求带来更多的突破并引领社会经济发展。

最后,对本专辑所有作者、审稿人及编辑部工作人员卓有成效的工作和辛勤的劳动表示衷心的感谢!

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Frontier of Electrochemistry

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Electrochemistry is a subject with a long history but full of vitality. Since Galvani discovered animal electrical phenomenon in 1791, electrochemistry has experienced several vigorous development periods. Electrochemistry is a subject that studies the transformation between electric energy and chemical materials. It is an important subject across the two fields of fundamental science (Science) and applied science (Engineering and Technology). The traditional idea is that electrochemistry is mainly about the conversion between electric energy and chemical energy, such as electrolysis and battery. However, electrochemistry is not limited to the electrochemical reaction, but also includes other physicochemical processes, such as electrochemical biosensor, photo electrochemistry, electroplating and corrosion. With the development of new technologies, such as spectroscopy, mass spectrometry, microscopy and computational simulation, electrochemical studies were largely reshaped.

At present, with the increasing demand for traditional energy replacement, the carbon peaking and carbon neutrality goals put on the agenda, the needs of clean energy vehicles and so on, the electrochemistry has ushered in the third golden development period. With the development of energy, material, environment, information, biomedicine and other areas, more and more talented researchers enter the field of electrochemistry. The number of participants in the national electrochemical annual conference has increased exponentially in the past decade. In 2019, the actual number of participants of the 20th National Electrochemical Society exceeded 5000.

In recent years, there have been many new frontier and hot topics in both fundamental and applied electrochemistry. In the field of electrochemical interface, the interface microstructure, high spatial temporal resolution method, adsorption kinetics and theoretical modeling are all at the key nodes to break through the limitations of previous limit. In the foreseeable future, there will be more breakthroughs in atomic and molecular level mechanisms and models. In the field of electrocatalysis, it has focused on the materials science, which has developed rapidly and stimulated by the need of fuel cell technology. With the increasing demand for renewable energy such as solar energy, perovskite based solar cells have become a hot spot. The trillion-dollar industrial supply chain of electrical vehicles has been spread all over the world. Energy conversion and storage will also be the key direction in the future and will play an important role in the fields of environment and economy. With the emergence of new technologies and concepts such as brain computer interface and metauniverse, the combination of microcircuit chip and bioelectrochemistry will be the next technological

revolutions.

This special collection (consecutively published in the journal's February and March issues) consist of a series of review and research articles on cutting-edge experimental technologies and theoretical methods, including synchrotron characterization technology, electrochemical voltammetry and chronoamperometry, the application of magnetic resonance in metal ion batteries, application of electrical transport spectroscopy in *in-situ* electrochemical interface measurement, single nanoparticle electrochemical measurement technology, and application of Mossbauer spectroscopy in electrocatalysis, electrochemical double-layer modeling and theoretical simulations of electrocatalysis based on the machine learning. The research progress of brain electrochemistry, application of various *in-situ* technologies in ORR research, development of electrochemical materials and research advances in fuel cells and batteries will also be introduced in detail in the special issue. The booming electrochemistry will certainly bring more breakthroughs to technologies and leading economic development in near future and beyond.

Finally, we would like to express our heartfelt thanks to all the authors, reviewers and editorial staff for their hard and fruitful work!