electrochem

MDPI

Editorial

Electrochem: An International Scientific Open Access Journal to Publish All Faces of Electrochemistry, Electrodeposition, Electrochemical Analysis, Electrochemical Sensing and Other Aspects about Electrochemical Reaction

Masato Sone

Institute of Innovative Research, Tokyo Institute of Technology, 4259-R2-35 Nagatsuta-cho, Midori-ku, Yokohama, Kanagawa 226-8503, Japan; sone.m.aa@m.titech.ac.jp

Received: 18 February 2020; Accepted: 18 February 2020; Published: 25 February 2020

Abstract: Our aim of journal *Electrochem* is to provide reviews, regular research papers, and communications in all areas of electrochemistry including methodologies, techniques, and instrumentation in both fundamental and applied fields. In this Editorial, the various technological demands for electrochemistry from academic and industrial fields are discussed and some problems to be solved in electrochemistry are proposed for next-generation science and technology. Under these technological demands, open access journals such as *Electrochem* will provide the solutions and new technology in electrochemistry to the world.

1. Introduction

Electrochemistry was originally a physical chemistry used to study the relationship between electricity and chemical reactions mainly in the solution state [1]. These reactions occur with electric charges between electrodes and an electrolyte. In recent years, electrochemistry has considered the reactions with electric charge in the solid state and the gas state, and thus becoming a chemistry used to study electron movement between atoms in liquid, solid, gas, and other states. Electrochemistry has become one of the key technologies in next-generation industry. Given this background, I discuss the role of *Electrochem* as international scientific open access journal in describing technological demands in electrochemistry.

2. For Nanotechnology

Electrochemistry has spread to applications in pure science as well as industries in the last several decades due to the development of nanotechnology and nanochemistry [2]. In nanotechnology, electrochemistry is one methodology used to monitor the change in nanostructures, molecular machines, and supramolecules and to control the motions, aggregations, organizations, structuring and conformational changes. On nano or picometer scales, monitoring the change in atoms and molecules is basically difficult in technically reasons. On these scales, *X*-ray diffraction, scanning electron micrography (SEM), and transmission electron micrography (TEM) are powerful tools in the immobilized state but struggle to detect changes in atoms and molecules. Electrochemical methods can be used to detect the change in atoms and molecules in reactions by the electron movement via electric current and electric potential as the summation. Electrochemical monitoring of nano-sized structures can be quantitative achieved because the electron movements between atoms and molecules can be stoichiometrically considered as electric current.

Electrochemistry can control the motions, aggregations, organizations, structuring, and conformational changes of nanostructures and molecular machines because the biochemical reactions in living organisms are related to electrochemical reactions and especially to signal transduction via nerve cells, which can be understood as a result of electrochemical reactions. Thus, controlling nano-size motion could be a new bio-electrochemical procedure in biomimetic science or in bio-inspired science. From this point of view, the field to be explored by electrochemistry is huge given nanotechnology, nanochemistry, and the applications in advanced sensor technology. The quantitative monitoring and control is attractive for nano-chemists.

3. For Electrodeposition

Another advantage of electrochemistry is the high reactivity of electrochemical reaction, including high reaction yield and high reaction efficiency. For example, the electrodeposition of nickel in a Watts bath, which is the conventional electrolyte used for electroplating, has over 95% current efficiency and over 95% of the electrons can be converted to deposited bulk nickel. Besides nickel, the reaction efficiencies of electrodeposited metals are relatively high compared with common organic reactions in solutions. Due to this high reactivity, electrodeposition is applied in the electronics industry.

Although electrodeposition is a key technology for electronics, many problems remain to be solved in electrodeposition. As is widely accepted, the compositions of the electrolyte and the additives can strongly affect the grain size, crystallographic orientation, and grain boundary modification of the deposited metals, and thus various properties including hardness, yield strength, thermal stability, and Young's modulus. Even now, the mechanisms of action of the additives in electrochemical reactions are unclear because a highly concentrated electrolyte cannot be expressed by the classical theory of solution but is categorized as a complex fluid. Recent quantum calculation technology of electrochemistry might solve the problem by describing the electrochemical reaction nearest the electrode, the nucleation mechanism of the electrodeposited metals, and the crystal growth mechanism of the electrodeposited metal. However, the same problem still exists for expressing highly concentrated electrolyte solutions. However, when we can examine a high concentrated electrolyte at the atomic level and predict the crystal nucleation on electrodes, a new era in material science will open.

4. For Electrochemical Sensor

Similar to electrodeposition, the high reactivity of electrochemical reactions, including high reaction yield and high reaction efficiency, can be important and useful for chemical sensors as reactions can be discussed stoichiometrically. The sensitivity of electrochemical sensors could theoretically be increased to the parts per trillion (ppt) level, like the noses of dogs. A dog's nose is one type of electrochemical sensors. We have not yet reached this level of sensitivity, but this could be one goal for electrochemical sensors.

We can imagine a world when the sensitivity of electrochemical sensors will be one million times higher than current sensors. The most sensitive sensors have enabled the early diagnosis of many incurable diseases including cancers, neuro-diseases, and diabetes [3]. Such high sensitivity seems to be impossible to attain, but such innovations could be realized in the coming decades.

5. For Energy Conversion

Recent advances in electrochemical technology, including lithium ion batteries, fuel cells, and supercapacitors, have contributed to the prosperity of our modern lives. Almost all people possess several lithium ion batteries in their mobile phones or smartphones. Hybrid, fuel cell, and electric vehicles use electrochemical energy convertors around the world, which is a sign of the success of electrochemistry in human history, for which J. Goodenough, M.S. Whittingham, and A. Yoshino became Nobel prize laureates for chemistry in 2019. Advanced electrochemistry could produce higher energy conversion efficiency, energy storage, and energy saving efficiency. However, many challenges remain in theoretical conversion efficiency due to materials science or the system-originated barriers.

6. Role of *Electrochem*

Above, I discussed several achievements in electrochemistry, problems to be solved, and challenges that can be used and address to explore new fields in electrochemistry. A journal such as *Electrochem* gathers solutions to these challenges and progress in the field of electrochemistry, providing open access to the publications. This open access journal will publish high quality peer-reviewed publications, allowing free access to the scientific community at any time, and, lastly, providing free access to the general public. Although several journals cover topics related to electrochemistry, this open access journal would be a platform to collect all electrochemistry and related disciplines under one journal. The online open access format will help and strengthen research communication between researchers and countries. It will also immensely help the scientific community in third world countries who cannot afford to subscribe to other related journals to have access to some novel research published in our open access journal. The main aim of this journal is to encourage scientists and research groups to publish theoretical and experimental results of research in all fundamental and applied fields of electrochemistry.

Each article will be subjected to a rigorous peer review. The peer review process is led by carefully selected world-renowned scientists from various disciplines that have broad expertise covering most aspects of electrochemistry. Once accepted, your article will be published immediately, providing access to millions of readers around the world. Our wish is that you will first select *Electrochem* as your journal to publish high quality, cutting edge research. *Electrochem* will consider original research articles, mini-reviews, reviews, communications, short notes, and suggestions for Special and Regular Issues in the fields of structural, functional, and experimental botany. We encourage your active participation by contributing articles to *Electrochem* in the near future.

Conflicts of Interest: The author declare no conflict of interest.

References

1. Paunovic, M. *Schleisinger, Fundamentals of Electrochemical Deposition*, 2nd ed.; John and Wiley and Sons: Hoboken, NJ, USA, 2006.
2. Cademartiri, L.; Ozin, G.A. *Concepts of Nanochemistry*; Wiley-VCH Verlag GmbH & Co. KGaA: Weinheim, Germany, 2009.
3. Sone, M.; Masu, K. *Novel Metal Electrodeposition and the Recent Application*; INTECH: London, UK, 2019.

© 2020 by the author. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (http://creativecommons.org/licenses/by/4.0/).