Yasumitsu Matsuo et al., Asian J Biomed Pharmaceut Sci, Volume:9
DOI: 10.4066/2249-622X-C2-019

allied academies

9th World Congress on
Chemistry and Medicinal Chemistry

May 13-14, 2019 | Prague, Czech Republic

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Protonics with tissue derived Biomaterials

Biomaterials are known to be useful in the medical and electrical fields. In the field of energy devices, biomaterials are also attractive materials leading a sustainable society, because these materials are abundant in the natural world and have a potential for the realization of zero emissions. Especially, ion generation and ion transport system with tissue-derived biomaterials are useful for energy sources such as fuel cells. Therefore, research on proton transport based on biomaterials is significantly important to realize a hydrogen energy society in which environmental loads can be responsibly reduced, and thus the investigations of new proton sources and/or new proton-transport materials based on biomaterials are strongly desired. It is known that biomaterials are exhibit proton transport using the mechanism of proton channel, proton pomp and water crosslinking. Recently, we have fabricated bio-based fuel cells using the electrolyte of tissue-derived biomaterials such as DNA, collagen and chitin, and we have found that biomaterials can be utilization as the electrolyte of fuel cells. These results indicate that the biomaterial becomes proton conductor. By impedance analyses, collagen, which is one of tissue-derived biomaterials, shows relatively high proton conductivity of 10^{-2} S/m in the humidified condition. Further, the power density in the fuel cell based on collagen electrolyte is approximately $10 W/m^2$ and we have found that these bio-based fuel cells light the LED. In the present talk, we will show the characteristics feature of bio-based fuel cells based on the electrolyte of tissue-derived biomaterials and will mainly discuss the mechanism on proton conductivity in tissue-derived biomaterials. In addition to these results, we will talk about proton sources based on biomaterials.

Speaker Biography

Yasumitsu Matsuo is a professor in Setsunan University and the chairperson of Department of Life Science in Faculty of Science & Engineering. He has taken a doctorate on science by photoconductivity in GeO_2/Ge bilayer film and thereafter has also investigated the mechanism of proton conductivity in hydrogen-bonded superprotonic conductors. Especially, he has found that superprotonic conductivity in hydrogen-bonded materials is realized by the competition between strain energy and proton kinetic energy including the entropy term. Currently he conducts research on not only superprotonic conductors but also proton conductors based on biomaterials. More recently, he has fabricated the fuel cell based on the tissue derived biomaterials and made clear the mechanism of proton conductivity in the humidified biopolymer. In addition, very recently, he has proposed new proton sources using biomaterials and contributes the development of hydrogen energy field as an officer in the Solid-State Ionics Society of Japan.

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