World Academy of Science, Engineering and Technology
International Journal of Bioengineering and Life Sciences
Vol:17, No:04, 2023

A Saltwater Battery Inspired by the Membrane Potential Found in Biological Cells

Authors : Ross Lee, Pritpal Singh, Andrew Jester

Abstract : As the world transitions to a more sustainable energy economy, the deployment of energy storage technologies is expected to increase to develop a more resilient grid system. However, current technologies are associated with various environmental and safety issues throughout their entire lifecycle; therefore, new battery technology is necessary for grid applications to curtail these risks. Biological cells, such as human neurons and electrolytes in the electric eel, can serve as a more sustainable design template for a new bio-inspired (i.e., biomimetic) battery. Within biological cells, an electrochemical gradient across the cell membrane forms the membrane potential, which serves as the driving force for ion transport into/out of the cell, akin to the charging/discharging of a battery cell. This work serves as the first step to developing such a biomimetic battery cell, starting with the fabrication and characterization of ion-selective membranes to facilitate ion transport through the cell. Performance characteristics (e.g., cell voltage, power density, specific energy, roundtrip efficiency) for the cell under investigation are compared to incumbent battery technologies and biological cells to assess the readiness level for this emerging technology. Using a Na^+-Form Nafion-117 membrane, the cell in this work successfully demonstrated behavior similar to human neurons; these findings will inform how cell components can be re-engineered to enhance device performance.

Keywords : battery, biomimetic, electrolytes, human neurons, ion-selective membranes, membrane potential
Conference Title : ICAEB 2023 : International Conference on Applications of Extreme Biomimetics
Conference Location : Rome, Italy
Conference Dates : April 13-14, 2023