Rapid Prototyping of a Pumpless Non-aqueous Organic Redox Flow Battery

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Abstract

Among many potential candidates in solving the ever-increasing demands for energy storage devices, redox flow batteries (RFBs) have demonstrated considerable promise. Redox flow batteries are electrochemical energy storage devices that utilize the reversible oxidation of two redox couples in liquid solutions to store energy. Unlike most other electrochemical storage systems, RFBs can be created with virtually any combination of power and storage capacity; this decoupling of storage capacity and rated power makes RFBs applicable in a wide variety of storage applications. In our research, we used stereolithography (SLA) to prototype small-scale RFB devices and utilized the high SLA resolution to create fine internal features that assist fluid flow. These features not only guide the organic electrolytes towards the reaction zones, but also ensure efficient mixing of reactant molecules within the chamber. We also performed a comprehensive chemical compatibility study of commercial additive manufacturing materials which can be utilized for general applications in electrochemistry. Using the results of this study, we created 3D printed RFBs and tested them using galvanostatic-potentiostatic cycling for several charge-discharge cycles, demonstrating that stereolithography can be used for fabricating a fully-functional organic redox flow battery.

Biography of Presenter

Shaikh Al Mahmud Bhuiyan is a PhD candidate in the department of Mechanical and Aerospace Engineering at the University of Kentucky. He has been working as a research assistant in the Precision Biosystems lab under the supervision of Dr. Christine Trinkle since 2021. He received his undergraduate degree in Mechanical Engineering from Bangladesh University of Engineering and Technology (BUET). His research interests include Electrochemical Energy Storage devices, Microfabrication, Microfluidics, Additive Manufacturing, Fire Dynamics etc.