3D-printed Flow Battery Leveraging Advanced Materials and Microscale Featured Electrodes.

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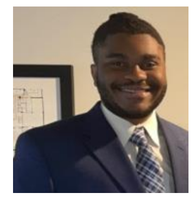
Abstract

Climate change necessitates a transition from fossil fuels to renewable energy sources, prompting the U.S. Department of Energy to actively seek alternative solutions for reducing carbon dioxide emissions. Among the promising technologies, redox flow batteries stand out, as they store electrical energy in liquid electrolytes containing dissolved chemical compounds. These batteries excel in large-scale energy storage, but their high cost and low energy density pose challenges. Vanadium redox flow batteries are commonly employed in this field. Nevertheless, there is a cost-effective alternative that emerges through additive manufacturing. The emerging technology of 3D-printed flow batteries aims to bridge the gap between scalability and cost in renewable energy. Additive manufacturing enables the utilization of complex geometries and the exploration of different prototypes while maintaining affordability. By leveraging these innovations, our goal is to enhance the viability and affordability of renewable energy storage solutions by developing corrosion-resilient electrodes compatible with harsh electrolyte solutions. In our approach, we employ boron-doped diamond deposition and molybdenum to produce robust and electrically conductive flow battery electrodes with high-surface area features. To facilitate 3D printing with molybdenum, we are utilizing an ultrasonic atomizer to generate metal powder feedstocks. The manifold structure for facilitating flow across the electrodes will also be produced via additive manufacturing using an acid-resistant SLA resin. Flow field patterns will be evaluated using fluid mechanics simulations to determine optimal structure geometries. The overall flow battery design will focus on addressing prior design concerns related to electrolyte cross-contamination, battery lifespan, and compatibility with scaling beyond lab-sized energy storage systems.

Biography of Presenter

Cobe Smart is currently an undergraduate student at the University of South Florida. He has gained valuable work experience as an undergraduate researcher, tutor, and peer mentor. Cobe is a graduate of the ReVAMP program and has been admitted into the Department of Mechanical Engineering. In his third year of studying mechanical engineering, he has demonstrated dedication and growth in the field. Cobe's achievements have been recognized as he has been featured on his university's YouTube channel for his involvement in living-learning communities. Looking ahead, his aspirations include becoming a professor in the field of engineering and owning a personal



library. Cobe's passion for education and engineering fuels his ambitions for a successful future in academia.