

Post-Doctoral Research Opportunity

Novel Fuel Cell Concepts

Research Description

Proton exchange membrane fuel cells (PEMFCs) are a promising technology due to their high energy conversion efficiency, low temperature operation, power density, and the high energy content of the fuels used. An essential PEMFC component is the flow-field plates (FFP) which serve the dual purposes of collecting current and distributing reactants across the electrodes. The FFPs are the fuel cell stack's primary source of weight and volume, as well as a significant cost factor, so new FFP approaches can make PEMFCs even more attractive. Innovative solutions are required to maximize power density and simplify system integration in order to meet the demands of compact design and cost reduction. The complex interplay of heat and mass transport, electric current flow, and materials makes this an interesting and fruitful research opportunity.

Our group is focused on a multi-year program to develop a new laminate fuel cell design through foundational materials research, laboratory experiments, and simulation. The goal is to realize a 5x cost decrease over state-of-the art (SOA) small fuel cells (0.5-5 kW) while retaining current performance.

The current program includes efforts to:

- Build the foundational knowledge to relate additive manufacturing parameters (materials, layering, assembly process, etc.) to catalyst structure and performance,
- Elucidate the optimal catalyst layer structure for a planar array of cells (aka "stackless" fuel cell),
- Design and synthesize a single test cell that can to match status quo stack performance, but with lateral current collection,
- Design and fabricate a 2-cell prototype fuel cell array to show that lateral current transfer through embedded interconnects is feasible, and
- Simulate fuel cell fluid dynamics and heat transfer to illuminate the optimal cell geometry.

These are not theoretical studies; results are verified by experiments and building prototypes. We are seeking applicants for postdoctoral positions who would like to work on these or similar research topics. Qualified candidates will:

- have a Ph.D. in Materials Science and Engineering, Mechanical Engineering, Electrical Engineering, Chemical Engineering, Chemistry, or a similar technical field
- be a US citizen or permanent resident, and
- be proficient in one or more of relevant electrochemical methods (e.g. I-V curves, EIS), PEMFC MEA fabrication, CAD drawing (SolidWorks), characterization techniques (e.g. SEM, XRD)

NRL Alternative Energy Section (Code 6173)

The NRL Alternative Energy Section conducts scientific and engineering research to improve the energy efficiency, resilience, and capabilities of the US Navy. In recent years we have focused on electrochemical devices such as fuel cells and batteries, and hybrid systems for vehicles and microgrids. We are vertically integrated with efforts ranging from laboratory studies to the development of full scale prototype systems. Many of our programs include collaborations with academic, government, and industrial organizations. Key competencies include electrochemistry, controls, optimization, simulation, and prototype development.



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Advisor and Application Process

If you are interested in this position, please contact Dr. Richard Stroman (info below). Details are provided on the NRL Postdoctoral Research Program website (https://nrl.asee.org/current_opportunities). Background on the history, mission, and resources available at NRL are described on our website (www.nrl.navy.mil).

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