A Novel Approach to Renewable Energy: Light Stimulated Active Cation Transport Membrane via Covalent Modification with a Photoacid

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This project provides a viable renewable energy source to combat climate change. Currently, solar panels are approximately 15% efficient, with a maximum efficiency of 34% due to the limitations of the materials used to manufacture them. This research utilizes photoacids, a recently discovered renewable solar generator with a longer life, potentially more cost-efficient design, and less toxic manufacturing process than current solar cells. In late 2017, the photoacid HPTS demonstrated the ability to covalently bond to a cation exchange membrane, nafion, making it an active membrane. When light excites this modified membrane in an electrochemical cell, it generates power, however efficiency is very low. This research project successfully synthesized the first active membrane made with a photoacid other than HPTS and demonstrated a nearly 5000% increase in efficiency. This synthesis was accomplished through modification of HPTS through several reactions and a long reflux of the membrane in solution of the HPTS derivative. The successful use of this photoacid is very promising for future research because it indicates that at least 4 more photoacids of similar structure could be used. Furthermore, it is likely that the single novel membrane created here is far from optimized and could further increase in efficiency. Ultimately, this experiment demonstrates rapid growth in the active membrane field and provides a path to the next viable renewable energy source.

Awards Won:
Arizona Public Service Company: Second Award of $2,000
University of Arizona: Renewal Tuition Scholarship
Arizona State University: Arizona State University Intel ISEF Scholarship