Project Title: Developing Bio-Inspired Condensers to Facilitate Solar Desalination

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Abstract: A World Resources Institute analysis indicates that 2.3 billion people globally live in environments where they do not have access to a sustainable fresh source of water. This number is projected to rise to 3.5 billion by 2025, emphasizing the incredible demand for new developments of fresh water resources. In response, scientists are investing in efficient water purification methods, most significantly desalination—the removal of salt ions from saline water sources. However, desalination plants require a significant amount of energy to operate, which dramatically reduces its applicability for areas that do not have the financial infrastructure to support the endeavor. Furthermore, desalination produces brine stream, highly concentrated salt solutions that are discharged into the environment, intoxicating plant life and reducing water quality. This study aims to improve the desalination process while emphasizing zero-liquid-discharge (ZLD) for regions victimized by water shortage. Using a nature-inspired synthetic leaf comprised of a graphene oxide (GO) based material, saline water is evaporated using sunlight. As the saline water is evaporated, the GO leaf parses the salt ions, allowing the resulting water vapor to be comprised primarily of pure water. The next phase of this research is to find an efficient way to capture the evaporated water vapor by developing a bio-inspired condenser that utilizes a superhydrophobic-superhydrophilic pattern to allow the water to coalesce and drip into a collection bin once it makes contact. The efficiency of condensation depends on variables such condensing surface temperature, water vapor convection rate, patterned vs. non-patterned surfaces, and ratio of hydrophobic to hydrophilic interlay. From these variables, several testing skids will be designed for experimentation, evaluating the amount of water collected per condenser configuration. An optimized condenser, coupled with the robust high performance of the synthetic leaf will push the progress of solar desalination and aid victimized regions.