Localizing Heat with Carbon Foam for Efficient Solar Desalination

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Concentrated solar technologies that concentrate sunlight on a receiver are becoming popular not just for electricity, but also for desalination. My research focuses on improving efficiency of solar desalination using carbon foam to localize heat by studying which thickness and treatment of carbon foam is most efficient in evaporating water when exposed to light. I obtained three carbon foam pads of different thickness for a series of experiments. Since carbon foam is hydrophobic I treated the pads in a warm dilute acid solution to make them hydrophilic. When hydrophilic, these pads are able to absorb sunlight and concentrate their heat at the top of a body of water and wick water to the surface. With the goal of making a small scale, cost efficient solar desalination device I designed a simple model device to test which thickness of foam could be used to evaporate the most water from a saltwater solution and which was most cost-effective. I tested it both outside and in a controlled environment. About twice as much water was recovered from the device using any carbon foam compared to the control when placed outside for a day. In the controlled environment the desalination device was illuminated by a light source overhead in a room at 20°C. I found that the thickest foam evaporated 56% more water in two hours than the control with no carbon foam and the thinnest 46% more water than the control. Though the thickest pad evaporated somewhat more water, the thinnest pad was most efficient in terms of water evaporated per thickness and water evaporated per cost. The use of the thin pad is especially promising for a cost-effective, portable solar desalination device. I am in the process of building and testing one that can purify water daily on the liter scale.

Awards Won:
Second Award of $2,000