Ultra-Resilient Durable Hydrophobic Condenser Surfaces for Sustainable Power Generation

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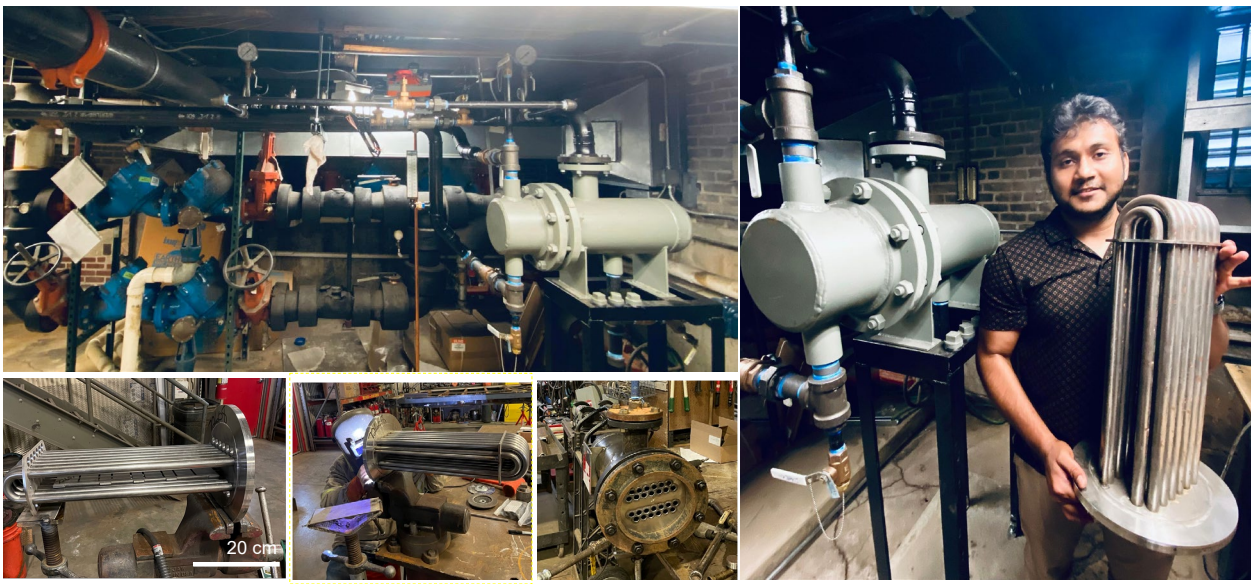
The first phase of this work was published in Nature Communications in 2023. Led by postdoctoral researcher Muhammad Jahidul (Jahid) Hoque and supervised by MechSE Professor Nenad Miljkovic, the next phase of the project aims to scale up the application of the developed coating, Fluorinated Diamond-Like Carbon (FDLC). A prototype shell-and-tube heat exchanger has been developed in collaboration with the Abbott Power Plant at the University of Illinois. The prototype features 13 U-shaped carbon steel tubes, each approximately 21 inches long and 1 inch in diameter. This prototype is integrated as a small condenser unit in the cycle and subjected to testing under power plant conditions, including high-pressure and high-temperature pure steam. The prototype and test rig are ready and undergoing a final round of inspection, with testing expected to start in mid-Fall 2024.

The outcomes of this power plant condition testing will demonstrate the readiness of the developed coating for real-life applications and address any challenges related to scale-up and surface durability in robust power plant environments. Furthermore, resolving these challenges has the potential to enhance the sustainability of energy generation sources, helping societies reach their climate change goals through reduced carbon emissions and lower utilization of environmentally harmful fossil fuels.



Images. The prototype heat exchanger test rig in the Mechanical Engineering Laboratory at Illinois (top left). Fabrication of the prototype heat exchanger (bottom left images). Jahid with the final prototype heat exchanger ready for testing in the Abbott Power Plant environment.