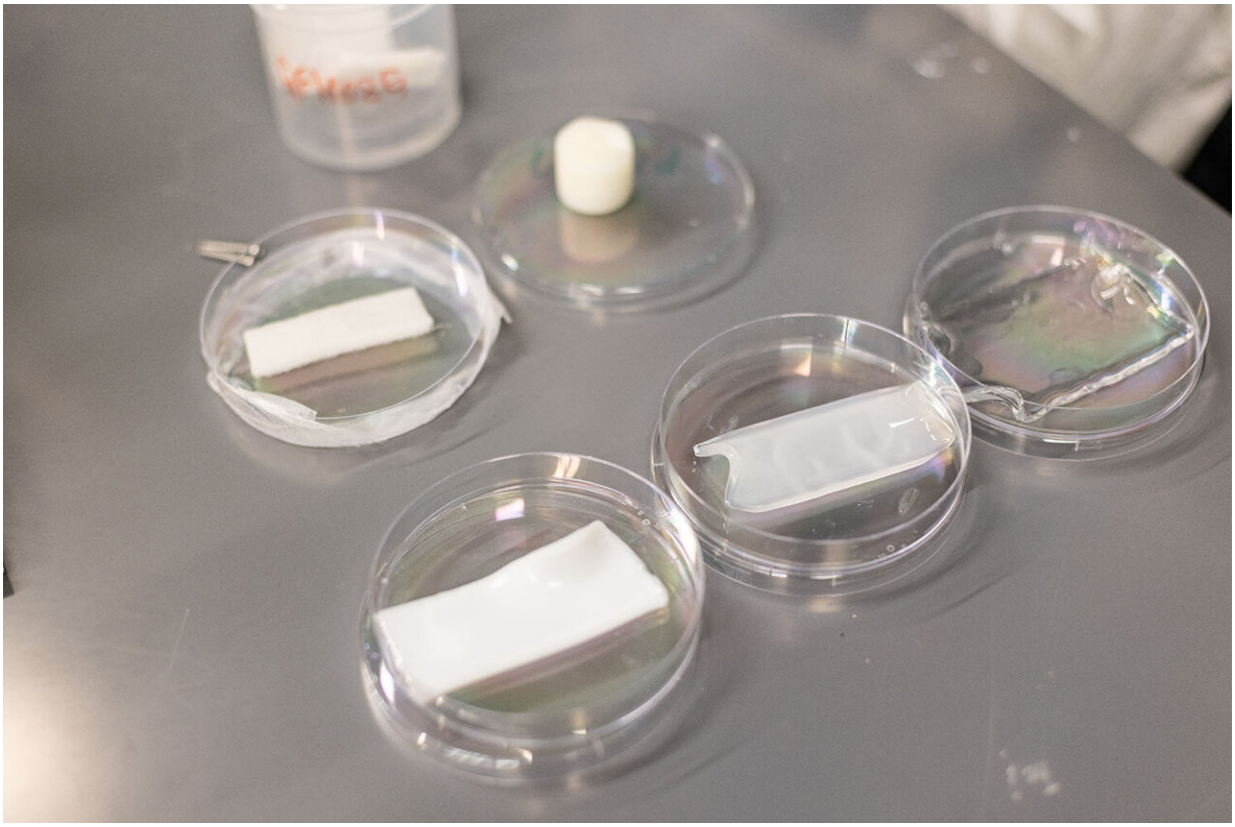
Quick-drying polymer may be key to more energy-efficient buildings

February 22 2024, by Kim Horner



Thermo-responsive polymer composites are shown in Dr. Shuang (Cynthia) Cui's lab. The polymer can make air conditioning more energy efficient by separating the dehumidification and heat removal processes and improving the most energy-consuming steps. Credit: University of Texas at Dallas

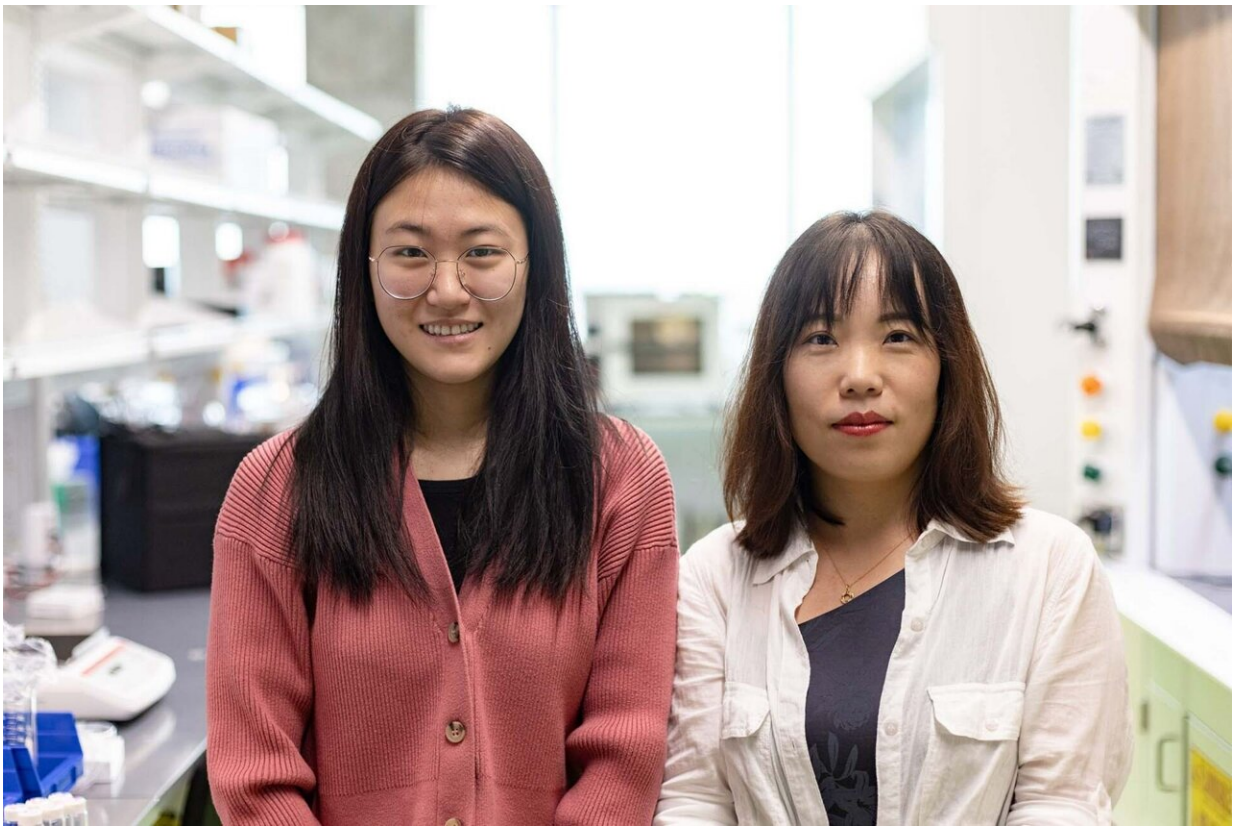
University of Texas at Dallas researchers and their collaborators are

developing a quick-drying polymeric desiccant that could dehumidify buildings using at least 30% less energy than conventional air-conditioning systems.

The researchers' thermo-responsive material absorbs moisture from air and dries quickly when exposed to low heat, said Dr. Shuang (Cynthia) Cui, principal investigator and assistant professor of mechanical engineering in the Erik Jonsson School of Engineering and Computer Science.

Cui envisions that inside a building's heating, ventilation and air-conditioning system, the desiccant would coat a rotating cylinder and absorb moisture from air during part of a rotation. Then, as the structure rotates, the water-filled material would move through a regeneration stage that exposes it to low heat to remove the absorbed moisture. The cycle would repeat continuously.

"Our goal is to develop the desiccant to help dehumidify and cool buildings more efficiently than conventional air-conditioning systems and lower carbon emissions significantly," Cui said. "It is imperative to improve dehumidification energy efficiency. Efficient air dehumidification represents an excellent opportunity to reduce energy use and greenhouse gas emissions to facilitate the sustainability and decarbonization movement to counteract climate change."



UT Dallas mechanical engineering doctoral student Leshi Feng (left) is one of the researchers working with Dr. Shuang (Cynthia) Cui to develop thermo-responsive polymers that could cool buildings more efficiently. Credit: University of Texas at Dallas

Air conditioners and electric fans account for 20% of the total electricity used in buildings worldwide, and demand is expected to soar, according to the International Energy Agency. Dehumidifying warm air can consume half or more of an air conditioner's energy.

The thermo-responsive desiccant can make air conditioning more energy efficient by separating the dehumidification and heat removal processes and improving the most energy-consuming steps. For example, unlike traditional air-conditioning systems, a system using the desiccant would

not need to cool coils at low temperatures to condense moisture from the air as part of the dehumidification process. Also, in contrast to a traditional air conditioner, the desiccant would likely not need to be heated to high temperatures to evaporate the collected moisture.

Cui and researchers from the National Renewable Energy Laboratory, where Cui previously worked, published a study detailing the optimal polymer structure in *Advanced Energy Materials*. Researchers continue to optimize the structure to help it absorb more moisture while also drying quickly at a low energy input.

Stefan said she and researchers in her lab are developing a range of thermo-responsive polymers to determine which formulas work best. She said she is impressed with Cui's work in applying the thermo-responsive polymer typically used in drug delivery applications to build dehumidification.

"Dr. Cui's creativity to bring these thermo-responsive polymers into this new application is amazing," Stefan said.

Stefan also said that Cui's collaboration with an industry partner is key to ensuring that the research will have a real-world impact.

"Dr. Cui's research is very application-driven," Stefan said. "She wants to make a difference, and with her industry partnership, she will take the thermo-responsive polymer to the next level."

More information: Paul W. Meyer et al, Engineered Polymer Architectures for Thermo-Responsive Desiccants in Dehumidification Applications, *Advanced Energy Materials* (2023). DOI: 10.1002/aenm.202300990

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