Atmospheric water harvesting using sulfonated porous organic polymers: is crystallinity key?

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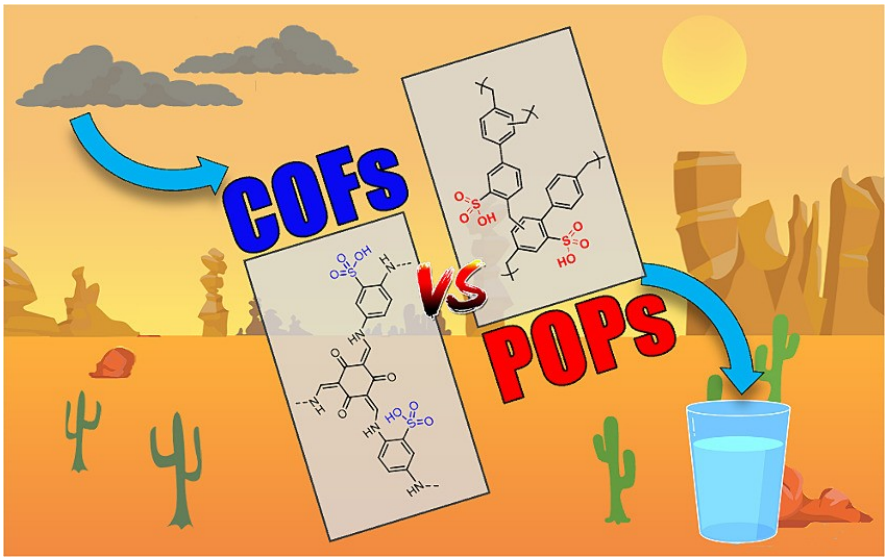

Despite access to clean drinking water being recognised as a human right by the United Nations, multiple parts of the globe are already facing significant freshwater scarcity and the number of affected areas is set to rise even further.[1] To tackle this issue, atmospheric humidity represents a supplementary source of fresh water, since it is generally not geographically restricted. In this talk, I will demonstrate the ability of a sulfonated hypercrosslinked polymer, SHCP-10,[2] and a sulfonated covalent organic framework, COF-SO_3H,[3] to repeatedly harvest significant amounts of water via direct air capture. High water uptake is retained in relative humidities as low as 10%, mimicking some of the harshest environments on Earth. To demonstrate the viability of water harvesting in real-world applications, we constructed an atmospheric water harvesting device. After conditioning in various RHs and temperatures, captured water was readily desorbed using simulated sunlight, presenting a low-energy route to water harvesting and adsorbent regeneration. Post-cycling, both materials retained excellent water uptake capacity over a broad range of relative humidities. We believe that this technique has the potential to greatly enhance our ability to address water scarcity concerns due to the use of low-cost and readily available reagents during synthesis and an almost limitless supply of water vapour from air. By contrasting a reticular material and an amorphous network, we will attempt to elucidate the role of crystallinity in sorbents for atmospheric water harvesting.

United Nations, The Sustainable Development Goals Report **2022**. https://unstats.un.org/sdgs/report/2022/ (accessed 2025-03-08).

[2] P. Schweng, F. Mayer, D. Galehdari, K. Weiland, R. T. Woodward, *Small* **2023**, 2304562. DOI: 10.1002/smll.202304562

[3] P. Schweng, C. Li, P. Guggenberger, F. Kleitz, R. T. Woodward, *ChemSusChem* **2024**, e202301906. DOI: 10.1002/cssc.202301906