

Ultra-thin carbon nanotubes can separate salt from seawater

Increasing demands for fresh water pose a global threat to sustainable development, resulting in water scarcity for four billion people, researchers said. | Photo Credit: [Reuters](#)

Scientists have developed carbon nanotubes over 50,000 times thinner than a human hair which can separate salt from seawater, an advance that may help solve the global water crisis.

Increasing demands for fresh water pose a global threat to sustainable development, resulting in water scarcity for four billion people, researchers said.

Current water purification technologies can benefit from the development of membranes with specialised pores that mimic highly efficient and water selective biological proteins.

Scientists, including those from Northeastern University in the U.S., developed carbon nanotube pores that can exclude salt from seawater.

The team found that water permeability in carbon nanotubes (CNTs) with diameters of 0.8 nanometre significantly exceeds that of wider carbon nanotubes.

The nanotubes, hollow structures made of carbon atoms in a unique arrangement, are more than 50,000 times thinner than a human hair.

The super smooth inner surface of the nanotube is responsible for their remarkably high water permeability, while the tiny pore size blocks larger salt ions.

“We found that carbon nanotubes with diameters smaller than a nanometre bear a key structural feature that enables enhanced transport,” said Ramya Tunuguntla, a postdoctoral researcher at Lawrence Livermore National Laboratory (LLNL) in the U.S.

“The narrow hydrophobic channel forces water to translocate in a single-file arrangement, a phenomenon similar to that found in the most efficient biological water transporters,” said Tunuguntla.

Computer simulations and experimental studies of water transport through CNTs with diameters larger than one nanometre showed enhanced water flow, but did not match the transport efficiency of biological proteins and did not separate salt efficiently, especially at higher salinities.

The key breakthrough achieved by the LLNL team was to use smaller-diameter nanotubes that delivered the required boost in performance.

“Carbon nanotubes are a unique platform for studying molecular transport and nanofluidics,” said Alex Noy principal investigator at LLNL.

“Their sub-nanometre size, atomically smooth surfaces and similarity to cellular water transport channels make them exceptionally suited for this purpose, and it is very exciting to make a synthetic water channel that performs better than nature’s own,” said Noy.

The research was published in the journal *Science*.

A study of nearly 300 people living in different parts of India found that nine single-base variants (single-nucleotide polymorphisms or SNPs) account

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