Man-made synthetic pores mimic important features of natural pores

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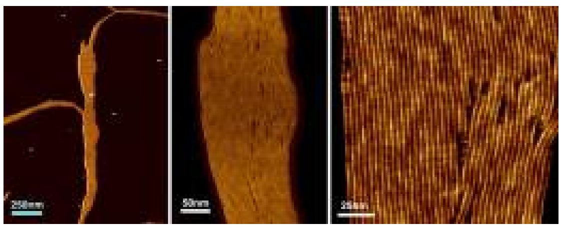

These are atomic force microscopy images of artificial ion channels created by scientists. The images are of the same sample, with increasing magnification. Credit: Bing Gong, University at Buffalo

Inspired by nature, an international research team has created synthetic pores that mimic the activity of cellular ion channels, which play a vital role in human health by severely restricting the types of materials allowed to enter cells.

The pores the scientists built are permeable to potassium ions and water, but not to other ions such as sodium and lithium ions.

This kind of extreme selectivity, while prominent in nature, is unprecedented for a synthetic structure, said University at Buffalo chemistry professor Bing Gong, PhD, who led the study.

The project's success lays the foundation for an array of exciting new technologies. In the future, scientists could use such highly discerning pores to purify water, kill tumors, or otherwise treat disease by regulating the substances inside of cells.

"The idea for this research originated from the biological world, from our hope to mimic biological structures, and we were thrilled by the results," Gong said. "We have created the first quantitatively confirmed synthetic water channel. Few synthetic pores are so highly selective."

The research will appear July 17 in *Nature Communications*.

The study's lead authors are Xibin Zhou of Beijing Normal University; Guande Liu of Shanghai Jiao Tong University; Kazuhiro Yamato, postdoctoral scientist at UB; and Yi Shen of Shanghai Jiao Tong University and the Shanghai Institute of Applied Physics, Chinese Academy of Sciences. Other institutions that contributed to the work include the University of Nebraska-Lincoln and Argonne National Laboratory. Frank Bright, a SUNY Distinguished Professor of chemistry at UB, assisted with spectroscopic studies.

To create the synthetic pores, the researchers developed a method to force donut-shaped molecules called rigid macrocycles to pile on top of one another. The scientists then stitched these stacks of molecules together using hydrogen bonding. The resulting structure was a nanotube with a pore less than a nanometer in diameter.

"This nanotube can be viewed as a stack of many, many rings," said Xiao Cheng Zeng, University of Nebraska-Lincoln Ameritas University Professor of Chemistry, and one of the study's senior authors. "The rings come together through a process called self-assembly, and it's very precise. It's the first synthetic nanotube that has a very uniform diameter. It's actually a sub-nanometer tube. It's about 8.8 angstroms."

The next step in the research is to tune the structure of the pores to allow different materials to selectively pass through, and to figure out what qualities govern the transport of materials through the pores, Gong said.

Provided by University at Buffalo