New material could be used in drug delivery system

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University of Toronto researchers have developed a new class of hybrid materials that could one day move drug delivery systems to the molecular level.
The paper published in the Nov. 26 issue of Science outlines how a U of T research team combined two classes of nanomaterials to create an entirely new composite structure. This new porous architecture may one day act as a nanoscale sieve, enabling researchers to release drug molecules in a slow and controlled way. "We hope one day to create a film of this material and spread it on the skin," says the paper's senior author University Professor Geoffrey Ozin of the Department of Chemistry. "By doing so, drugs can be diffused through the skin, rather than injection, which would guarantee a continuous flow of a drug molecule at a tunable rate and concentration."

To create this new material, Ozin and post-doctoral fellow Kai Landskron combine dendrimers - a special class of highly organized nanosized molecules - with a porous silica material. The functionalized dendrimers are dissolved together with a template in an aqueous solution. The solution causes the dendrimers to react with water and then assemble around the template into a new class of materials called periodic mesoporous dendrisilicas (PMD). The PMD is a honeycomb-like structure with pores measuring about 10 billionth of a metre - and pore walls with internal pores of about one billionth of a metre. This hierarchical construction can enable drug molecules to slowly slip through the various pores to target a particular disease.

"The problem with current drug delivery systems like simple syringes is that when you inject the drug, you often inject initially too high a concentration to ensure it stays in the system, which can be toxic," says Landskron, the study's first author. "With this new type of material, you could release the drug at an appropriate rate and avoid these negative effects. You can fine tune absorption and desorption and allow it to be far more defined than ever before."

Landskron says the new hybrid material may also have potential use in microelectronic applications. As chip components are gradually shrinking to tiny dimensions, new materials are needed to provide packaging on the nanoscale level. "Currently, the silica that insulates chips becomes less effective as they become smaller," says Landskron. "The new porous material could show greater insulating abilities and are interesting as packaging material in microelectronics."

According to Ozin, the next step is to expand on the various ways to alter the structure of PMDs, tailor their properties and develop the basic science that will underpin the exploitation of the PMDs in both drug delivery and microelectronic applications.

Ozin is a Canada Research Chair in Materials Chemistry. The research received funding from the Natural Sciences and Engineering Research Council of Canada.

Source: University of Toronto