New geometries: Researchers create new shapes of artificial microcompartments

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(Phys.org)—In nature, biological functions are often carried out in tiny protective shells known as microcompartments, structures that provide home to enzymes that convert carbon dioxide into energy in plant cells and to viruses that replicate once they enter the cell.

Most of these shells buckle into an icosahedron shape, forming 20 sides that allow for high interface with their surroundings. But some shells—such as those found in the single-celled Archaea or simple, salt-loving organisms called halophiles —break into triangles, squares, or non-symmetrical geometries. While these alternate geometries may seem simple, they can be incredibly useful in biology, where low symmetry can translate to higher functionality.

Researchers at Northwestern University have recently developed a method to recreate these shapes in artificial microcompartments created in the lab: by altering the acidity of their surroundings. The findings could lead to designed microreactors that mimic the functions of these cell containers or deliver therapeutic materials to cells at specific targeted locations.

"If you want to design a very clever capsule, you don't make a sphere. But perhaps you shouldn't make an icosahedron, either," said Monica Olvera de la Cruz, Lawyer Taylor Professor of Materials Science and Engineering, Chemistry, and (by courtesy) Chemical and Biological Engineering at Northwestern's McCormick School of Engineering and one of the paper's authors. "What we are beginning to realize is maybe these lower symmetries are smarter."

To create the new shell geometries, the researchers co-assembled oppositely charged lipids with variable degrees of ionization and externally modified the surrounding electrolyte. The resulting geometries include fully faceted regular and irregular polyhedral, such as square and triangular shapes, and mixed Janus-like vesicles with faceted and curved domains that resembled cellular shapes and shapes of halophilic organisms.

More information: A paper about the research, "Molecular Crystallization Controlled by pH Regulates Mesoscopic Membrane Morphology," was published November 27 in the journal *ACS Nano*. pubs.acs.org/doi/abs/10.1021/nn304321w

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