New Self-Assemble Building Blocks for Nanotechnology

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University of Michigan researchers have discovered a way to self-assemble nanoparticles into wires, sheets, shells and other unusual structures using sticky patches that make the particles group themselves together in programmed ways. This method could be used to fabricate new materials and devices for nanotechnology.

Using computer simulation of model particles, Zhenli Zhang, U-M research fellow in chemical engineering, and Sharon Glotzer, U-M associate professor in chemical engineering, studied the self-assembly of particles with sticky molecular "patches" on their surfaces---discrete interaction sites that cause particles to stick together at just the right places to make the grouping organized. The paper, "Self Assembly of Patchy Particles," appeared in Nano Letters this month.

The results of the simulations showed that if surfaces of particles could be patterned with patches of molecules, they could make the particles assemble into different shapes. The trick, according to the researchers, is using patches that are strongly directional and attract and repel specific parts of other particles, much like proteins do.

This finding is important because the biggest impediment to developing nanotechnology is figuring out how to build the tiny structures, which are only as big as the smallest viruses. Because they are so small, nanodevices will not be built by the traditional means of using workers in factories or assembly lines. Rather, scientists must develop ways to make the devices assemble by themselves in precise ways for specific applications.

This type of self-assembly happens constantly in nature, but engineering it in the lab, so that eventually scientists can predict their shapes and use the shapes for specific applications, is another matter.

According to the paper, many of the structures they were able to predict with the model will prove useful in device fabrication. For example, sheets of spheres with tunable structures (an ordered arrangement of points that can be changed) may serve as novel materials with optical and mechanical properties.

The chains, rings and twisted and staircase assemblies could serve as basic structural units to further prepare materials with more complex structures such as tubes, helices and 3-D networks that could in turn, serve as scaffolds or templates for assembly of electronic or optical components, or as channels for transport of liquids or molecules.

Source: University of Michigan