CORNELL NEWS

Inspired by nature, Cornell chemist finds way to makebiodegradable plastic that imitates bacteria

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NEW ORLEANS -- Finding an economical way to make a polyester commonly found in many types of bacteria into a plastic with uses ranging from packaging to biomedical devices is a long-held scientific goal. Such a polymer would be a "green" plastic, in that it would be biodegradable.

Geoffrey Coates, a professor of chemistry and chemical biology at Cornell University, Ithaca, N.Y., has partially achieved this goal by discovering a highly efficient chemical route for the synthesis of the polymer, known as poly(beta-hydroxybutyrate) or PHB. The thermoplastic polyester is widely found in nature, particularly in some bacteria, where it is formed as intracellular deposits and used as a storage form of carbon and energy. And yet it shares many of the physical and mechanical properties of petroleum-based polypropylene, with the added benefit of being biodegradable.

Coates reported on his research group's work with PHB in the first of two papers presented at the 225th national meeting of the American Chemical Society in New Orleans at 3:30 p.m. CST Sunday, March 23.

PHB currently is produced through a costly, energy-intensive biological process involving the fermentation of sugar. However, the Coates group's chemical route, once perfected, "is going to be a competitive strategy," the Cornell researcher believes.

In order to produce the polymer, the process first requires a monomer, in this case a lactone called beta-butyrolactone. This reacts with a zinc complex catalyst, discovered by Coates in the late 1990s, to make PHB.

The problem faced by the Coates group has been that beta-butyrolactone is a "handed" molecule, that is, it has two mirror images, like hands. Polymers produced from a mixture of two-handed forms have very poor properties. The researchers have been focusing on the development of a new catalyst for the production of the desired single-handed form of beta-butyrolactone, a process called carbonylation. The new catalyst, based on cobalt and aluminum, facilitates the addition of carbon monoxide to propylene oxide, an inexpensive ring compound called an epoxide. By using the commercially available handed form of propylene oxide in the reaction, the corresponding handed form of the lactone can be formed rapidly.

Coates is convinced that, "our carbonylation and polymerization processes are, in our opinion, the best." He adds, "A purely chemical route to a polymer that occurs in nature and is easily biodegradable is highly desirable."

Members of the Coates group at Cornell involved in the research include Yutan Getzler, Lee Rieth and Vinod Kundnani, all Ph.D. candidates, and postdoctoral associate Joseph Schmidt. The work was supported by the National Science Foundation, the Arnold and Mabel Beckman Foundation, the David and Lucile Packard Foundation, the Nanobiotechnology Center at Cornell and the Cornell Center for Materials Research.

Related World Wide Web sites: The following sites provide additional information on this news release.

Geoffrey Coates: http://www.chem.cornell.edu/department/Faculty/Coates/coates.html

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