

Colorado State Chemists Develop Recyclable, Biodegradable, Petroleum-Free Plastic

Source: sustainablebrands.com

Published: December 15, 2015



[Hannah Furlong](#)

Chemists at **Colorado State University** (CSU) have developed a [new biodegradable polymer](#). The plastic is made from the bio-renewable monomer Gamma-butyrolactone (GBL) and it converts back to GBL when heated — ready for reuse. The new material, called poly(GBL), could represent a fully recyclable and biodegradable alternative to petroleum-based materials.

GBL is a colorless liquid that is a common solvent and reagent used as a flavoring, cleaning solution, superglue remover, and for other purposes. Scientists previously believed the monomer was too stable to polymerize, but [Presidential Green Chemistry Award-winning](#) professor **Eugene Chen** and postdoctoral fellow **Miao Hong** suspected that some of the previous research was incorrect.

“Don’t even bother with this monomer,” Chen summarized the message from textbooks and academic literature. “You cannot make a polymer out of it because the measured reaction thermodynamics told you so.”

Chen and Hong used low temperatures and both metal-based and metal-free catalysts in [their research](#) to synthesize the polymer into different shapes, such as linear or cyclic. Poly(GBL) is chemically equivalent to a [commercial biomaterial](#) called poly(4-hydroxybutyrate), or P4HB. P4HB is derived from bacteria, which is a more expensive and complex process than how most plastics are made. Poly(GBL) could serve as a material replacement. An hour of heat between 220-300 degrees Celsius converts it back to its original molecular state.

“More than 200 pounds of synthetic polymers are consumed per person each year — plastics probably the most in terms of production volume. And most of these polymers are not biorenewable,” Chen said. “The big drive now is to produce biorenewable and [biodegradable polymers](#) or plastics. That is, however, only one part of the solution, as biodegradable polymers are not necessarily recyclable, in terms of feedstock recycling.”

Recyclable plastics are ‘downcycled’ each time they are processed. Bottles and other plastics can be repurposed into new products but not necessarily with the same level of quality. Compostable plastics made from polylactic acid (PLA) are biodegradable, but [cannot be reconstituted](#) into their original monomeric states without forming byproducts. True “chemical recyclability” was unheard of prior to this development.

“In my 15 years at CSU, I would probably call this my group’s most exciting piece of work,” Chen said. “This work creates a class of truly sustainable biopolymers, as they are both biorenewable and recyclable, based on a bioderived monomer previously declared non-polymerizable.”
