Recycle And Reuse...With Electrochemistry: Electrifying The Chemical Decomposition Of Plastic

University of Colorado Boulder

Polyethylene terephthalate, known as PET, is a common plastic found in water bottles, blister packs and even polyester fabric. Although recycling initiatives have increased, plastic waste remains a worldwide problem, as most waste ends up in landfills.

“We pat ourselves on the back when we toss something into the recycling bin, but most of that recyclable plastic never winds up being recycled,” noted Oana Luca, an assistant professor at the University of Colorado Boulder (CU Boulder)

To address this problem, Luca and fellow CU Boulder chemists developed an “electrifying” new way to recycle. Luca utilized electrolysis, the process of using electricity to break molecules apart, frequently for water and salt molecules.

However, the molecules of plastic have stronger bonds than the molecules found in water and salt. The voltages applied in classic electrolysis methods were not sufficient enough to divide the molecules of PET plastic. Therefore, her team introduced an additional component to electrolysis to assist in breaking down the molecules: a chemical reaction.

The decomposition process begins with grinding PET plastic into a powder and adding it into solution along with a chemical solution combined with salt. This salt serves as a mediator, providing an additional electron to the PET molecules which causes them to break apart much more easily.

Through this electrochemical decomposition process, the materials are changed mechanically, returning to their original molecular components, which can then be used again in synthesizing future materials. Luca compared the process to Lego®: taking a creation and deconstructing the pieces to reconstruct it into something new.

Since beginning her research at CU Boulder, Luca continues to partner with the university. She initially worked with Venture Partners at the university to patent this PET recycling technology and introduced the idea in an NSF I-Corps Hub: West RegionStarting Blocks course, the university's program dedicated to customer discoveries.

Currently, the team reports that they can break down about 40 milligrams, approximately “a small pinch” of PET plastic over several hours with mediated electrochemical decomposition. With additional research and resources, the team hopes to accelerate and expand the process, breaking down multiple types of plastic — not just PET — at once.

“If I were to have my way as a mad scientist, I would use these electrochemical methods to break down many different kinds of plastic at once,” Luca said. “That way, you could, for example, go to these massive garbage patches in the ocean, pull all of that waste into a reactor and get a lot of useful molecules back.”

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