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Electrifying Polymer Chemistry: New Strategies to Functionalize, Depolymerize, and Deconstruct Macromolecules

ABSTRACT

Electrochemistry is a powerful tool to break and form challenging chemical functionality. We demonstrate that electrochemical-induced decarboxylation enables reliable post-polymerization modification and degradation of polymers. Polymers containing N-(acryloxy)phthalimides were subjected to electrochemical decarboxylation under mild conditions, which led to the formation of transient alkyl radicals. This enables the production of poly(ethylene-co-methyl acrylate) and poly(propylene-co-methyl acrylate) copolymers, which are difficult to synthesize by direct polymerization. Spectroscopic and chromatographic techniques reveal these transformations are near-quantitative on several polymer systems. Electrochemical decarboxylation also enables the degradation and depolymerization of all-methacrylate poly(N-(methacryloxy)phthalimide-co-methyl methacrylate) copolymers with high efficiencies. A deep understanding of the radical processes at place in this chemistry also inspired new approaches to polymerizing ultra-high molecular weight polymers. Taken together, this mechanistic exploration reveals how emerging radical chemistries are an important tool to generate and post-synthetically modify macromolecules.

BIO

Austin M. Evans is an Assistant Professor at the University of Florida where he holds appointments in Chemistry and Materials Science & Engineering. Prior to joining the University of Florida, Austin studied at Columbia University as a Postdoctoral Schmidt Science Fellow. Before his postdoctoral training, Austin completed his Ph.D. in Chemistry at Northwestern University as an NSF Graduate Research Fellow and an International Institute for Nanotechnology Ryan Fellow. For his contributions to many areas of chemistry, engineering, and physics Austin has been recognized with numerous awards including the 3M Non-Tenured Faculty Award, ACS POLY Henkel Award, MOF2020 Early Career Award, Foresight Institute Vision Fellowship for Molecular Electronics, and the IUPAC-Solvay International Award for Young Chemists.



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