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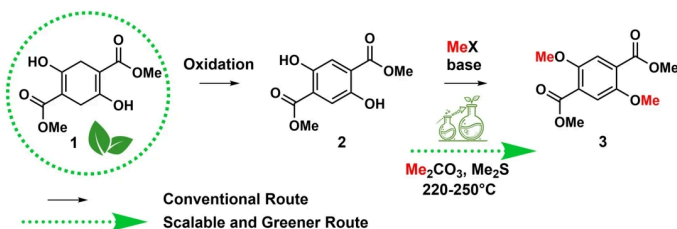
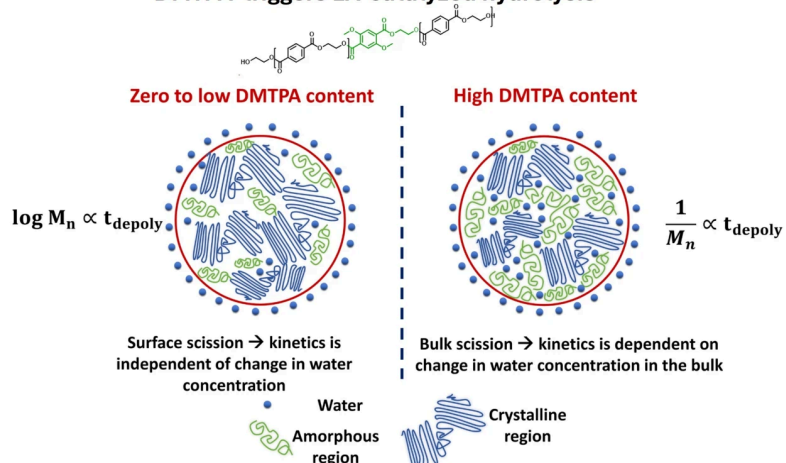
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Trojan terephthalates for scalable PET depolymerization

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OVERVIEW COMMENTS

The escalating reliance on plastics and the price volatility of fossil fuels demand recycling strategies that recover monomers without degrading material quality. Polyethylene terephthalate (PET), despite being the most widely produced and recycled polyester, degrades during thermomechanical recycling, limiting recycled material to low-end applications. Herein, we demonstrate that incorporating dimethoxy-functionalized Trojanterephthalates (DMTPA) at 2.5-5 mol% enables depolymerization to monomers in pressurized subcritical water at 180 °C. We developed a “scalable O-methylation route” to synthesize DMTPA using DMC (dimethyl carbonate) and DMS (dimethyl sulfide) under conditions that result in DMC decomposition (250 °C, 1100-1500 psi), generating supercritical CO₂ and methanol in situ, eliminating the need for toxic alkylating agents such as methyl iodide, dimethyl sulfate, and other cosolvents. Density functional theory (DFT) reveals that ortho-methoxy groups twist the ester carbonyl out of plane by 24 °, disrupting resonance and increasing susceptibility to nucleophilic attack. DMTPA facilitates Lewis acid coordination and reduces crystallinity, leading to rapid bulk hydrolysis; calculations show that ZnCl₂ is more effective than Zn(OAc)₂ for depolymerization. Pilot-scale production (>70 kg), solid-state polymerization to bottle-grade intrinsic viscosity, and injection stretch blow molding of commercial spirit bottles confirm full drop-in compatibility with existing manufacturing infrastructure. The limited incorporation of Trojan terephthalates maintains the performance properties of conventional PET while adding inherent chemical recyclability, thus creating a synthetic approach to circular plastics

Synthesis of 2,5-dimethyl dimethoxy terephthalate (DMTPA)**DMTPA triggers LA-catalyzed hydrolysis**

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Synthesis of Trojan terephthalates for triggering lewis acid catalyzed polyester depolymerization

Presenters

- DD** Dhananjay Dileep (/b/sp/dhananjay-dileep-293850)
Iowa State University of Science and Technology
- WT** Will Teggatz (/b/sp/will-teggatz-452883)
Iowa State University of Science and Technology

Co-Authors

- JK** Jared Kaczor (/b/sp/jared-kaczor-379222)
Iowa State University of Science and Technology
- DP** Deep Patel (/b/sp/deep-patel-452882)
Iowa State University of Science and Technology
- AA** Aleksei Ananin (/b/sp/aleksei-ananin-341596)
Iowa State University of Science and Technology
- AS** Aadhi Subbiah (/b/sp/aadhi-subbiah-379223)
Iowa State University of Science and Technology



Samuel Chambers (/b/sp/samuel-chambers-397321)
Iowa State University of Science and Technology



Demetrius Finley (/b/sp/demetrius-finley-447166)
North Carolina Agricultural and Technical State University



Michael Forrester (/b/sp/michael-forrester-111006)
Iowa State University of Science and Technology



Vivek Garg (/b/sp/vivek-garg-378506)
Iowa State University of Science and Technology



Abby Remus (/b/sp/abby-remus-452884)
Iowa State University of Science and Technology



George Kraus (/b/sp/george-kraus-324843)
Iowa State University of Science and Technology



Luke Roling (/b/sp/luke-roling-447980)
Iowa State University of Science and Technology



Eric W. Cochran (/b/sp/eric-cochran-2181)
Mark Jane Skogen Hagenson and Randy L. Hagenson Professor, Iowa
State University of Science and Technology

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