

Catalysis for Plastic Upcycling

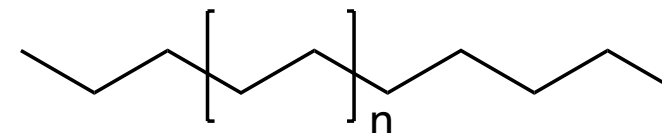
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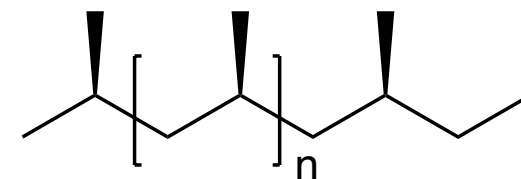
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Mission: To create a new generation of catalysts that enable chemical upcycling of energy-rich macromolecules

- Plastics are an energy problem: production consumes an annual equivalent of 6-8% worldwide oil and LNG
 - Polymers generate 300 M tons of municipal solid waste (MSW) worldwide (2015)
 - Polyethylene (PE), polypropylene (PP), and polystyrene (PS) make up ~55% of this waste
- Polymer recycling is energetically and economically limited
 - Most plastics are designed for single-use applications (packaging)
 - Physical properties degrade in recycling or reprocessing
 - Most commodity plastics are highly engineered materials
- Upcycling (chemical conversion) should add value
 - Energy value of current PE + PP + PS waste \approx 1.3 B barrels of oil
 - US consumes \sim 7.3 B barrels/year

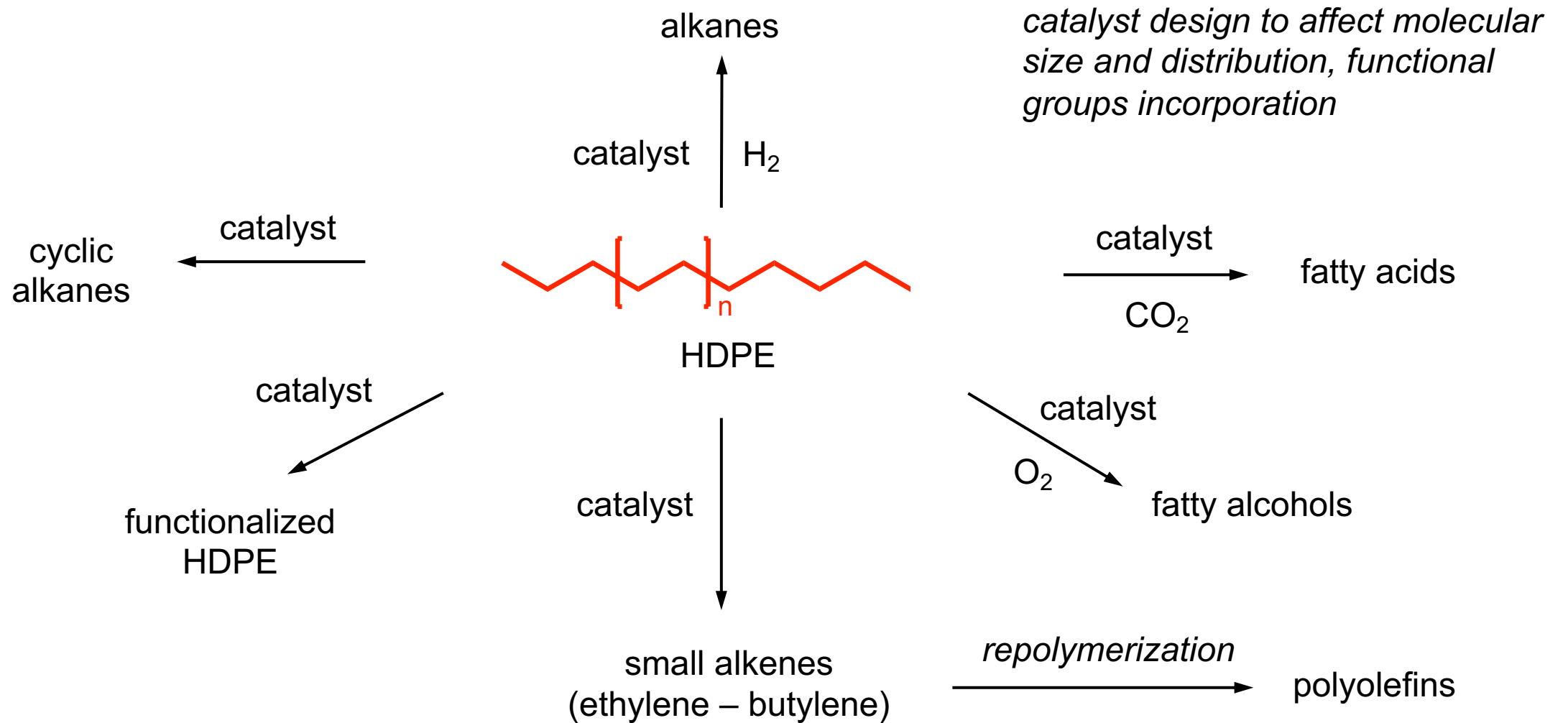


**high density
(HD)PE**

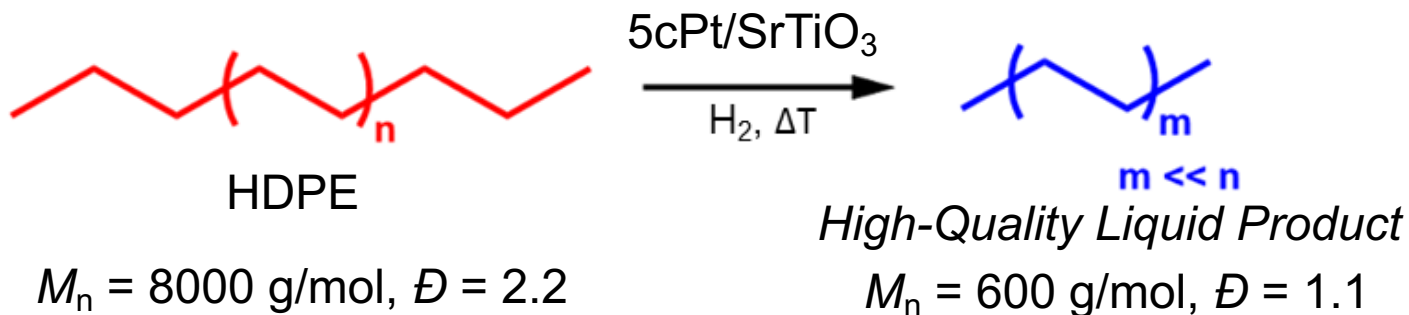


**isotactic
(i)PP**

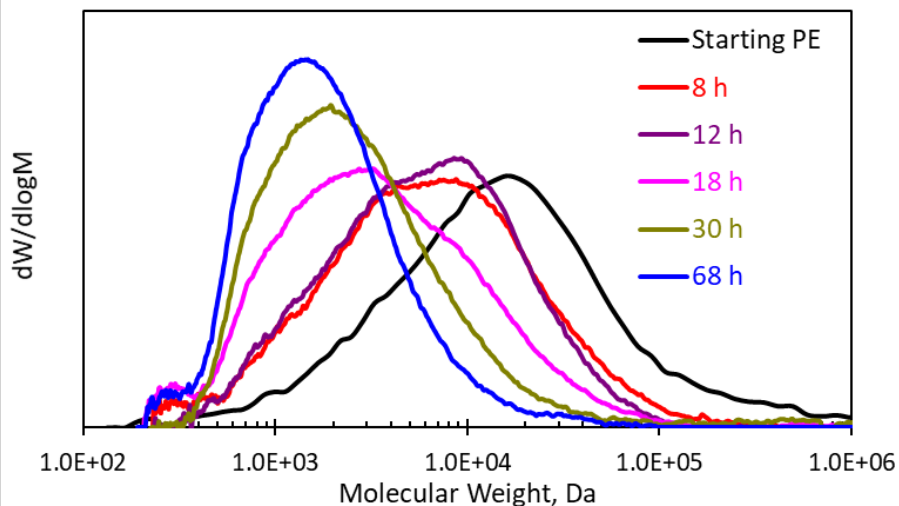
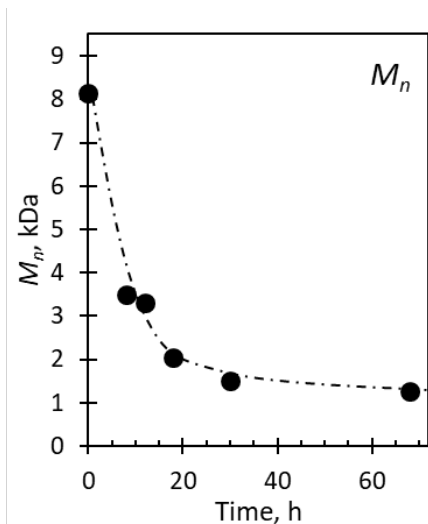
New Catalytic Reactions



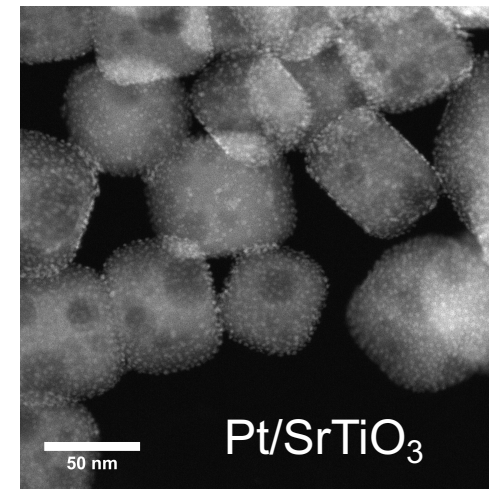
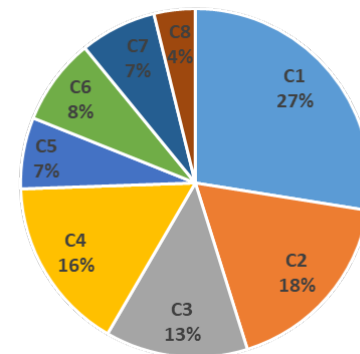
Polymer Upcycling: Catalytic Hydrogenolysis using Pt/SrTiO₃



Catalytic Reaction Conditions
 170 psi H₂, 300 °C, Solvent-free



<1% light alkanes



Celik, G.; Kennedy, R. M.; Hackler, R. A.; Ferrandon, M.; Tennakoon, A.; Patnaik, S.; LaPointe, A. M.; Ammal, S. C.; Heyden, A.; Perras, F. A.; Pruski, M.; Scott, S. L.; Poepelmeier, K. R.; Sadow, A. D.; Delferro, M., Upcycling Single-Use Polyethylene into High-Quality Liquid Products. *ACS Central Science* **2019**. DOI: 10.1021/acscentsci.9b00722

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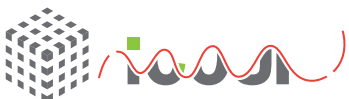
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