Department of Materials Science and Engineering,
PhD Defense

Polyhydroxyalkanoates biosynthesis and resulting polymer structures

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Although synthetic plastics are ubiquitous today, they are typically made from petroleum and are difficult to recycle, leading to microplastic pollution. Polyhydroxyalkanoates (PHAs) are a class of natural polymers synthesized by microorganisms under certain nutrient limiting conditions with an excess source of carbon present. Poly(3-hydroxybutyrate) (PHB) the most widely studied homopolymer of PHAs, is highly crystalline, brittle, and difficult to process. However, copolymers of PHB which contain increasingly longer side chains break up the regularity of the polymer packing order, are more elastic, and have lower melting temperatures. These copolymers are easier to process and contain properties that are similar to polyolefins, making them an excellent candidate for single-use plastics that contribute the most by sector to global plastic waste generated. However, only microorganisms with specific metabolic pathways have the capacity to synthesize PHAs with more than 4 carbons in the monomer unit, which is usually acquired by evolutionarily adapting to their environment. Extreme environments, dynamic environments, and environments with a diverse carbon supply have all been linked to microorganisms with the capability to produce PHA copolymers. In this work, PHAs producing-microorganisms were isolated from a previously unexplored dynamic environment. The effect of including different carboxylic acids in the growth media was determined, and the resulting polymers were characterized.