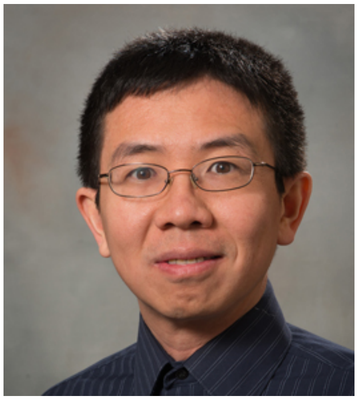

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Biosynthesis of Ethylene Glycol from Renewable Resources

Abstract.

By using starting materials derived from renewable feedstocks, biosyntheses of commodity and specialty chemicals are emerging as indispensable alternatives to address the sustainability issues of the chemical industry. Because commercial chemicals are often 'man-made' molecules, efforts are increasingly directed to the discovery and the development of novel biosynthetic pathways for the production of industrial chemicals. The proposed research focuses on the development and implementation of an artificial biosynthetic pathway for microbial synthesis of ethylene glycol (EG), a nonnatural molecule and a bulk industrial chemical that is mainly used in polyester manufacturing, such as polyethylene terephthalate (PET). Protein engineering will be applied to improving the catalytic efficiency of a key pathway enzyme, carboxylic acid reductase (CAR). Metabolic engineering will be applied to maximizing the carbon flux into the EG pathway in the *E. coli* host strain. To facilitate the protein engineering, efforts will be directed to obtaining the first crystal structure of a CAR enzyme. Due to versatile applications of CAR, this work has broad impacts on the field of bio-based chemical and biofuel syntheses. Furthermore, the proposed work will establish a novel growth-coupled selection scheme to allow rapid sampling of large number of enzyme mutants. The selection scheme has the potential to be adapted for directed evolution experiments of enzymes with similar cofactor requirement. Successfully implementation of the protein and metabolic engineering strategies will lead to the first *E. coli* strain that can synthesize EG from diverse forms of renewable feedstocks.