Robust Cytochrome P450-P(3HB) Complex for Solar-to-Chemical Conversion Platform

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Cytochrome P450 monooxygenases which catalyze a remarkable variety of oxidative trans-formation are of exceptional interest for the synthesis of fine chemicals. However, due to the in-stability and requirement of expensive cofactor, P450s have yet to be extensively used for industry. Here, we develop a solar-driven chemical conversion system that combines visible light-driven NADPH regeneration and in situ immobilization of P450-BM3 on biopolymer granules. Through fusion with phasin, P450-BM3 can be easily immobilized on poly(3-hydroxybutyrate) granules in Escherichia coli. The immobilized P450 exhibited higher stability and catalytic activity compared to free P450 against changes of pH, temperature, and concentrations of urea and ions. Through photochemical NADPH regeneration using eosin Y as a photosensitizer, P450-P(3HB) complex successfully catalyzed a visible light-driven O-dealkylation reaction. Furthermore, large scale of P450 light catalytic reaction was performed with P450-P(3HB) complex in long term scale. Using the robust P450-P (3HB) complex and a solar-tracking module, we achieved a P450-catalyzed reaction under natural sunlight for four consecutive days on a preparative reactor scale (500 mL).