Chemical & Environmental Engineering

2009 - 2010 Colloquium Series

James Liao

Professor

Department of Chemical and Biomolecular Engineering

UCLA

Synthetic Metabolism for Fuels and Chemicals

Global energy and environmental problems have stimulated increased efforts in synthesizing fuels and chemicals from renewable resources. However, through millions of years of evolution, nature only uses a limited set of metabolites to perform all of the biochemical functions. As such, our choice of biochemical fuel production is limited. To increase the metabolic capabilities of biological systems, we have expanded the natural metabolic network using a non-natural approach.

We first expanded the metabolic system to produce higher alcohols. Compared to the traditional biofuel, ethanol, higher alcohols offer advantages as gasoline substitutes because of their higher energy density and lower hygroscopicity. In addition, branched-chain alcohols have higher octane numbers compared to their straight-chain counterparts. However, these alcohols cannot be synthesized economically using native organisms. We successfully engineered an *Escherichia coli* strain to produce higher alcohols including isobutanol, 1-butanol, 2-methyl-1-butanol, 3-methyl-1-butanol and 2-phenylethanol from a renewable carbon sources. This strategy leverages the host's highly robust amino acid biosynthetic pathway and diverts its 2-keto acid intermediates for alcohol synthesis. In particular, we have achieved high yield, high specificity production of isobutanol from glucose.

We further developed a non-natural chain-elongation pathway to produce abiotic longer chain keto acids and alcohols by engineering the chain elongation activity of 2-isopropylmalate synthase and altering the substrate specificity of downstream enzymes through rational protein design. When introduced into *E. coli*, this non-natural biosynthetic pathway produces various long-chain alcohols with carbon number ranging from 5 to 8.

Friday February 26, 2010

9:30 - 10:30 AM

Bourns Hall A265

UC RIVERSIDE UNIVERSITY OF CALIFORNIA | Bourns College of Engineering