ABSTRACT
Engineering microbial metabolic pathways offers the opportunity to produce renewable fuels, chemicals and materials. For this technology to be economically viable, engineered microbes must produce target compounds in high titers, yields, and productivities. Microbes evolved sophisticated regulatory network to adapt to various environments for cell growth, but not to produce chemicals in large quantities and with high efficiencies. To improve microbial production, we developed sensor-regulators to dynamically control the expression of pathway genes, which balance the metabolism of heterologous pathways and prevent the accumulation of intermediates to toxic levels. We also develop sensor-selectors to continuously select for high-performing, non-genetic variants within iso-genetic populations. Using the designed synthetic regulatory systems, we have demonstrated significantly improved product titers, yields, productivities and genetic stability on multiple biosynthetic pathways. Design principles of these synthetic regulatory systems should be useful in other areas of biotechnology, enabling new avenues of research and applications.

BIOGRAPHY
Fuzhong Zhang is an associate professor in the Department of Energy, Environmental & Chemical Engineering at Washington University in St. Louis. He received his bachelor degree at Peking University, master at McMaster University, Ph.D at University of Toronto, and postdoctoral training at UC Berkeley/ Joint BioEnergy Institute. His current research focuses on developing synthetic biology tools and systems for the sustainable production of structurally-defined chemicals and high-performance materials. Since he joined Washington University in 2012, he has received numerous awards, including DARPA Young Faculty Award (2013), ORAU Junior Faculty Enhancement Award (2013), NSF CAREER Award (2014), Young Investigator Program from AFOSR, ONR, and HFSP (2015), NASA Early Career Faculty Award (2015), Biotech & Bioeng Daniel Wang Award (2016), Dean’s Faculty Award for Innovation in Research (2016), and the SIMB Young Investigator Award (2017).