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GENETICALLY ENCODED BIOSENSORS AS TOOLS FOR THE UP-CYCLING OF AROMATIC-BASED FEEDSTOCKS

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Modern society is largely dependent on natural geological supplies, including crude oil, coal, and natural gas. Our reliance on these fossil fuels is however responsible for many causes of global concern. These concerns, along with energy security, waste management and global climatic change concerns require a shift towards a sustainable economic solutions with alternative routes to chemicals, fuels, and energy from renewable and waste feedstocks. In particular, aromatic based-feedstocks constitute ideal raw materials to shift towards a bio-based society. Metabolic engineering and synthetic biology present an emerging opportunity to develop direct metabolic routes to value-added products from these sources. However, the success of biosynthetic pathways is highly context-dependent. Genetically encoded biosensors are ideal genetic tools that can provide an optimal solution, as they can be deployed to translate target metabolite concentrations into useful detectable and actionable signals amenable to high-throughput analysis and dynamic cell regulation, ultimately enhancing product yields and titers.

Protocatechuic acid (PCA) is a key important aromatic intermediate in the enzymatic-mediated degradation of aromatic compounds in nature. Hence, this substrate finds numerous applications in the bioremediation and up-cycling of abundant environmental pollutants, including halogenated aromatics, aromatic hydrocarbons and several synthetic polymers. Aromatic compounds found in lignocellulose are also processed into biomass or higher value products via the intermediate PCA. In this study, we have developed a series of transcriptional biosensors that are functional in *Pseudomonas putida* and are highly active towards numerous aromatic compounds, including PCA and various homologues and other related aromatics, such as terephthalic acid. We further study their applications in the dynamic regulation of catabolic pathways and enzymatic screening towards the valorization and up-cycling of aromatic-based feedstocks and wastes, including lignocellulose and poly(ethylene terephthalate) plastic wastes.