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Biomass deconstruction towards total carbon utilization for future bio-refineries

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Lignocellulosic biomass is the most abundant source of organic carbon on Earth and presents the only option with the potential to economically and sustainably replace fossil resources for large-scale production of renewable chemicals, materials and liquid fuels. However, past methods to achieve the facile deconstruction of biomass has been challenged by processing difficulties, low product recovery and excessive materials and energy costs. Here, we evaluate lessons learned over decades of research and outline key features in advanced technologies for biomass pretreatment that are necessary to help achieve more economically feasible deconstruction of biomass. We demonstrate how atomic-scale interactions simulated by supercomputers could help understand key chemical mechanisms responsible for biomass breakdown to help improve design of bulk-scale pretreatment processes that can be subsequently integrated with biological or catalytic conversion pathways. The objective of biomass deconstruction is then to maximize the total carbon utilization of biomass to products by improving recovery of sugars and lignin and managing the removal of trace inorganics. Towards these goals we have created a breakthrough pretreatment technology called as CELF (Co-solvent Enhanced Lignocellulosic Fractionation) that provides a front-end platform for biomass-based bio-refineries to achieve the highest utilization of sugars to liquid fuels and lignin to fuels and value-added co-products. CELF can then be coupled with both advanced biological and catalytic methods to help achieve unprecedented performance at significantly lower material and energy costs.

Biography

Charles M Cai is a Research Engineer and Adjunct Professor at UC Riverside, USA. He is also Co-Founder and CTO of MG Fuels, a bioenergy company. His research focuses on the biological and catalytic processing of lignocellulosic biomass. He is responsible for creating and advancing the CELF process, one of the most promising new biomass conversion technologies, to enable affordable community scale production of power and liquid fuels. In 2017, he was listed in Forbes' 30 Under 30 in Energy. He has received his PhD in Chemical and Environmental Engineering at UC Riverside and his BS in Biochemical Engineering at UC Davis.

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