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Microfluidics for Protein Expression, Purification, and Screening

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Microfluidics for Protein Expression, Purification, and Screening

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High-throughput (HTP) technologies for protein expression and screening are critical to the rapid development of cost-effective bioconversion processes. For example, methods are required for functional analysis of tens of thousands of wild-type and engineered lignocellulose degrading enzymes, as well as for full characterization of the plant cell wall synthesis machinery with a throughput of thousands of gene clones per year. We are developing novel integrated microfluidic platforms for small-scale (sub- μ g levels) high-throughput protein expression, purification, and screening. The promising enzyme candidates can thus be rapidly identified and this paves the path for scaled-up production of enzymes. Our microfluidic platform seeks to integrate fractionation of cell lysate, purification, characterization, and screening. A key to facile integration of these steps, which often features incompatibility of scale and modes of operation, is the replacement of centrifugation with liquid-liquid extraction for fractionation of cell lysates. We are also developing microfluidic cell-free-protein synthesis technology for simplified HTP protein expression. In addition, we are integrating on-chip protein characterization steps such as reversed-phase chromatography, SDS-PAGE, and native PAGE. Finally, we are developing colorimetric and fluorescence-based enzyme assays for screening lignocellulases and glycosyltransferases.