Electrical & Computer Engineering

D E F E N S E

Louisiana State University

Polymer Microstructures for Advanced Biomanufacturing

a dissertation to be defended by

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Abstract—The continued growth of the biopharmaceutical industry has amplified the demand for scalable, robust, and resource-efficient platforms for large-scale mammalian cell culture. Recent advances in microfluidic technologies have shown the potential to improve the performance of cell culture systems; however, applying such approaches to large-scale processes remains challenging due to limitations in scalability and operational efficiency. This dissertation addresses these challenges through two independent but conceptually related technological developments. First, a roll-to-roll (R2R) fabrication system was developed for the scalable production of hollow microcarriers (HMCs) that provide three-dimensional microenvironments suitable for culturing shear-sensitive cells in stirred-tank bioreactors. The continuous R2R process enables high-throughput fabrication of HMCs, achieving significantly enhanced production rate for successful commercialization. Second, a dialysis bioreactor based on a rolled scaffold (RS) was developed to support long-term adherent cell culture with reduced medium consumption. Compared with conventional perfusion systems, which continuously remove secreted products along with the culture medium, dialysis enables selective exchange of nutrients and metabolites while retaining large biomolecules such as monoclonal antibodies (mAb). This enables sustained mAb production with improved resource efficiency. Together, these developments demonstrate strategies for extending the advantages of microfluidic technologies to scalable biomanufacturing applications.

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Where: **Room 3285 Patrick F. Taylor Hall**
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