Session 1: Systems and Synthetic Biology for Improved Biologics Production

Session Chairs: Bhanu Mulukutla (Pfizer) and Nicole Borth (BOKU Vienna)

Since 1987, mammalian host systems have evolved to be the workhorses of biologics production despite their intertwined complex physiological functions making their control in cell culture processes challenging. Systems biology, which employs omics technologies integrated with mathematical modeling, provides a way to study these complex physiological functions in a holistic manner. Synthetic biology complements this by providing advanced genetic engineering tools and circuits to modulate such complex physiological functions. Over the last decade, systems biology approaches were employed by the bioprocessing community in an exploratory fashion towards attaining deeper understanding of routinely used cell lines and cell culture processes. More recently, the combination of systems biology and synthetic biology is applied towards attaining tangible solutions for specific cell culture process related questions by enhancing and/or fine tuning relevant cellular physiological functions. This session will mainly focus on such studies that demonstrate tangible outcomes to modulate cell growth, protein or viral vector/particle production, product quality or any other aspects of biologics production. In addition, this session will also focus on studies contriving novel solutions in the form of bioinformatics tools or mathematical models to address challenges with handling, analysis and interpretation of big data typically generated as part of systems and synthetic biology efforts.

Session 2: Cell Line Development: Current State and Future Directions

Session chairs: Zhimei Du (Merck) and Mark Smales (University of Kent)

Advances in molecular biology and genome editing tools have expedited cell line development for the production of high-quality biologics. These technologies are complemented by increased genome sequence availability, better understanding of the control of gene expression in industrial host-vector systems, and progress in high-throughput screening strategies. As a result of these rapidly evolving capabilities, the design and application of cell engineering strategies has never been better positioned, nor the opportunities and potential more exciting, to deliver new engineered host cells with enhanced capacity to produce high value and quality biologics. This session focuses on all these aspects that underpin cell engineering, covering novel approaches and/or technologies to deliver engineered and/or selected cells for establishing recombinant cell lines with improved performance. Topics may include direct host cell engineering (e.g., genome editing, site-specific integration or synthetic biology approaches to redesign the cell, manipulation of non-coding RNAs), vector engineering (e.g., vector design and components, inducible systems, codon optimization, control of transcription and translation), novel methods for recombinant clone generation, selection and screening, and novel methods for ensuring, predicting and characterizing clone stability and determining/extend the limit of in vitro cell age for production.
Session 3: Advances in Cell Culture Control and Analysis

Session chairs: Marcella Yu (Boehringer Ingelheim) and Sarika Mehra (IIT Bombay)

Understanding of the relationship between cell culture process control and desirable product quality attributes in protein therapeutics has matured significantly over the past several years. Sophistication in control strategies, analytical outputs and models that link the two has advanced both at the laboratory scale as well as demonstration of implementation and benefit at GMP scale. This session will capture advances in the area of process understanding and process control with the focus on achieving desired product quality attributes. Additionally, topics will include state-of-the-art Process Analytical Technology (PAT) and tools that allow feedback control of the upstream processes, as well as work that demonstrates implementation of these PAT tools in a GMP facility. Modeling of cell culture processes, such as genome-scale in silico modeling to predict and modulate product quality responses (including Critical Quality Attributes), and smart integration of artificial intelligence to close the gaps between predicted models and experimental data will also be covered. Novel approaches to cell culture process control strategies will also be considered for this session.

Session 4: Engineering Technologies for Cell-based Therapies

Session chairs: Chris Ramsborg (Juno) and Krish Roy (Georgia Tech)

Cell-based therapy has emerged as a potentially transformative modality for treating complex diseases and is rapidly becoming an important product area for the biopharmaceutical industry. However, reproducible and scalable manufacturing of therapeutic cells, with high and consistent quality at a reasonable cost has been challenging—underscoring the need for significant innovations. This session will focus on engineering tools and technologies for reproducible manufacturing of therapeutic cells, including licensed cell types like T cells, and emerging cell types like HSCs, MSCs, and iPSCs. Specifically, tools and methods related to advanced cell engineering and universal/allogeneic cell production, improved bioprocessing to reduce culture time and cost or to selectively expand the most safe and potent cell subsets, deep cell characterization including multi-omics approaches, in-line process and product monitoring, feedback and process control, data analytics for critical quality attribute (CQA) and critical process parameter (CPP) identification, and process and supply chain modeling, will be discussed.

Session 5: Scale-up and Scale-out in Biopharmaceutical Manufacturing: Challenges and Solutions during Technology Transfer

Session chairs: Inn Yuk (Genentech) and Raghu Shivappa (Takeda)

Traditionally, increased demand for biopharmaceuticals has been met through the use of scale-up strategies with increasing size of the production bioreactors. Recent advances in process intensification and continuous bioprocessing have resulted in consideration of approaches from scale-up (increasing batch size) to scale-out (increasing batch number) in biopharmaceutical manufacturing. Technology transfer is key to a successful scale-up and scale-out of cell culture processes from development to manufacturing and across sites. In addition to conventional tech transfer methods, improved scale-down models and implementation of PAT tools are becoming increasingly important to manufacture
complex molecules in high cell density platforms. Unexpected shifts in key performance indicators and critical quality attributes are often observed during process scale-up/scale-out due to differences in the cell culture environment and the associated biological response. This session will focus on sharing challenges encountered and solutions implemented for scale-up and/or scale-out of cell culture processes during technology transfer. This session will showcase successful adoption of new paradigms and technologies, with a focus on increasing process robustness or productivity through innovation. Case studies on overcoming challenges with scalability and robustness of enabling technologies such as perfusion and single-use systems will also be included. Innovative solutions to address product comparability challenges and learnings gained from interactions with Health Authorities are encouraged.

Session 6: Production of Viral Vectors and Other Emerging Therapeutic Modalities

Session chairs: Scott Estes (Codiak Bio) and Jennifer Maynard (University of Texas-Austin)

This session will highlight recent bioprocessing progress beyond the well-established realm of protein therapeutics, emphasizing production of viral vectors and other emerging therapeutic modalities. First, the present and anticipated surge of clinical trials that rely on viral vectors for gene delivery indicates that gene therapy is becoming a viable therapeutic modality and may soon provide cures for a broad range of human diseases. To support the application of gene therapies beyond orphan indications, significant strides are needed in viral production process efficiencies and industrialization. This session encourages submission of abstracts describing innovative work enhancing viral vector productivity and robustness through vector engineering, host cell line optimization and/or process development. Second, this session will highlight other emerging modalities. Presentations describing improved cell-based processes for the production of vaccines, oncolytic viruses, exosomes and other non-viral therapeutic delivery systems are encouraged.

Session 7: Advances in Integrated Continuous Bioprocessing

Session chairs: Massimo Morbidelli (ETH Zurich) and Chetan T. Goudar (Amgen)

Progress continues to be made on the application of continuous principles in CHO-cell based bioprocesses. Advances both on technical and financial dimensions have been made and there is improved understanding of capital deployment, speed, and productivity targets necessary to make continuous processes an attractive commercial manufacturing approach. Additionally, multiple sponsors have had positive interactions with regulatory agencies who have expressed support for new technologies. We are also starting to accumulate GMP experience around unit operations leading up to drug substance manufacturing, including the deployment of PAT and process control strategies to enable reliable operation. The intent of this session will be to highlight the state-of-the-art in integrated continuous bioprocessing for drug substance production. The latest advancements in cell culture and purification processes with an emphasis on integration will be included as will topics related to PAT and process control. Topics related to process economics that can direct strategies for the design, construction, and licensure of manufacturing plants will also be discussed.