

# **Challenges and Opportunities for Enzyme, Cell Line and Reaction Engineering to Address Increasing Molecular Complexity in Biopharmaceuticals**

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The biopharmaceutical industry has, by all measures, been a tremendous success, in terms of both human health and economics. Recent advances such as the introduction of antibodies that specifically target tumor antigens have offered new hope in cancer therapy while the application of vaccines has practically eliminated once dreaded infectious diseases such as polio, mumps, and German Measles. Due to the enormous benefit provided by such treatments, large pharmaceutical companies such as Merck and Pfizer have become fixtures on the Fortune 500, while newer biotechnology companies such as Genentech and Amgen have skyrocketed up the financial charts. Despite these successes however, the industry is challenged. The reduced rate of introduction of novel chemical entities and the ever increasing costs of bringing each new drug to market suggests that the pharmaceutical business model is broken. At the same time the complexity of the diseases afflicting human health continues to increase as seemingly does the complexity of the molecules required to combat these diseases. This presentation will focus on the challenges and opportunities in enzyme, cell and reaction engineering that arise as a result of addressing this increasing molecular complexity as exemplified by recent advances in Merck.