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Session 6

Enzymatic Processes and Enzyme Production

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Production and use of enzymes is changing dramatically through innovations in gene expression and protein engineering. Since the establishment of these technologies, scientists and engineers deal with a noticeably different set of challenges in process development. In the 1970s and 1980s, maximum product yield meant empirical and statistical optimization of media and growth. Today, it is more than likely that products are derived from modified genes, driven by optimal promoters, in optimized production host systems cultivated in economical scale processes.

There are at least three distinct stages in the development of enzymatic processes. First, the enzymes must be discovered or engineered and the genes encoding them determined. Next, commercial scale expression systems employing suitable hosts must be developed and shown cost-effective. Finally, the actual conversion process must be defined and proven before the end-user will buy the enzymes. Most enzyme producers also offer a service to address the customer's enzyme-use questions and problems, as well as some level of performance guarantee. This session reported examples of most of these important stages of enzyme-based processes.

The first symposium paper, presented by G. Whited, entitled "Enzymatic Processes and Enzyme Production," defined the philosophy of the session well. Real-world examples of the production of commercial enzymes were given from the Genencor International experience. Most of the other papers in this session relate progress at the "proof of concept" stage. Although the oral paper entitled "Biotechnical Processing of Natural Fibers to Industrial Products" by P. Vilppunen from the University of Oulu was not given, the abstract submitted described progress made in converting natural fibers (polysaccharides) to components that are useful to industry using pectinases and other enzymes. S. Decker from NREL gave a paper entitled "Discovery and Comparison of Thermophilic and Mesophilic Polysaccharidases for Industrial Applications," which described a Laboratory-funded Initiative to discover new polysaccharidases and provide them to industry at low cost. This type of activity is especially well suited to national labs, because they conduct long-term, high-risk research well and new contractual tools, such as the CRADA (Cooperative Research and

Development Agreement) permit effective partnership with industry. M. Orr from ORNL presented an oral paper entitled "Enzymatic Conversion of Maple Tree Sap Sucrose to Hydrogen," which reviewed an enzymatic process that produces the gaseous product, hydrogen. This work highlights a more nontraditional use of biomass, because a difficult to handle, nonliquid fuel is the target. In paper 5, P. Oriel from Michigan State University reported results of a project entitled "Acrylamide Production Using Thermostable Enzymes." Acrylamide is a key industrial starting material for a wide range of synthetic materials and chemicals. Enzymatic production of acrylamide may offer a reduction in the use of chemical catalysts that present cleanup and disposal problems, and certainly elevates this process to a Green Technology. J. Barton from ORNL described control of production of chiral compounds using lipases in a gas-phase reaction in the paper entitled "Gas-Phase Enzyme Catalysis for Esterification and Transesterification Reactions Using Immobilized Lipase. The final symposium paper, paper 7, was given by S. Burton from Rhodes University in Grahamstown, South Africa and described the use of hydantoinases in industrial processes that convert chiral amino acids to intermediates used in the production of pharmaceuticals and fine chemicals.

To conclude, the original session chairs M. Himmel and K. Sanford would like to thank T. Vinzant and G. Whited for conducting the session in their absence. In some ways, Session 6 was an extension of Session 5, with special emphasis on discovery, production, and the process. Unlike the other sessions; however, biomass feedstocks were not the only substrates considered in this session, especially if the enzymatic process described was novel.