FY 2009-2010 Project: Enzymatic Polymerization
Project Number: BUSC-09

Project Team: Gisela Buschle-Diller (PI), Auburn University; Email: buschgi@auburn.edu; phone: 334-844-5468; Graduate Students: Shuying Long

Project Goals

In the previous project phases, conducting polymers have been synthesized by enzymatic means. The oxidoreductases used for this process are still fairly costly. Therefore, the immobilization of the biocatalyst in a matrix is being explored in the next step. Normally, the enzyme has to be deactivated after the reaction is completed. Immobilization is a process in which the enzyme is entrapped in a support material and thus available for several further reaction batches. The challenge in regard to finding a suitable immobilization support lies in the correct balance of availability and reactivity of the enzyme, and the stability the support system has to offer to the catalyst. On the other hand, separation of the catalyst from the reaction system has to be fast and effective, so that the reaction could transition from batch to a continuous process under ideal conditions. Several techniques have been established for immobilizing enzymes based on chemical and physical methods. Chemical immobilization might include the formation of covalent bonds with a possibly pre-activated support or a crosslinking reaction with the matrix. This process, of course, can have a strong influence on the catalytic efficiency of the active center of the enzyme. Physical immobilization might involve simple adsorption or entrapment methods which will leave the structure of the enzyme to most part intact. However, in this case, the reuse of enzyme is limited. Regardless of the techniques, it is of adamant importance to minimize the disruption of the natural structure and thus the function of the enzyme's active site(s).

Relevance to Industry:

It is necessary for the traditional polymer manufacturing industry to rethink the approach to successful synthesis without reliance on foreign oil resources. In the future, enzymes will replace conventional chemical catalysts in many areas of organic synthesis. Research in this area will help to promote a more sustainable approach to a wide variety of materials at reasonable costs.