הטכניון - מכון טכנולוגי לישראל

TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY

הפקולטה להנדסה כימית
ע״ש וולפסון
The Wolfson Department of Chemical Engineering

Wolfson Department of Chemical Engineering Seminar
Monday, July 28rd, 2025 at 13:30
Room 6

Evaluation of lipases activity in aqueous cellulose-coated emulsion microparticles

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PhD Final Seminar

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With global concerns for sustainable resources and reduction of waste and hazards due to microplastics significant attention is aimed at biodegradable plastics from natural sources, of which polymers based on lactic acid (LA), such as poly(lactic acid) (PLA) and LA co-polyesters, are of high importance. By most current practice, LA is synthesized biochemically while polymerization is carried out chemically, by a sequence of reactions including oligomerization, dehydration to lactide (LA cyclic dimer) and ring-opening polymerization.

Lipases are an attractive alternative as an environmentally friendly way to synthesize polyesters. However, the environment in which lipases operates has an impact on its catalytic effect. Enzymes used for polymerization of aliphatic polyesters are lipases that in nature hydrolyze fatty acids in an aqueous environment. Additionally, the natural environment for enzymes is water, in which their highest catalytic efficiency is achieved. Emulsion polymerization offers an advantage by enabling polymerization in water, in contrast to traditional organic solvent-based processes.

This project aims to develop a novel process for the production LA and its subsequent enzymatic oligomerization using cellulose-coated emulsion microparticles as microreactors for a cascade of biochemical reactions. Emulsion-based esterification of LA with lipase faces two main challenges: the high acidity of LA, which can lead to acid-induced enzyme inactivation, and competition of hydrolysis due to the abundance of water.

The emulsion microparticles are created by homogenizing a suspension of cellulose hydrogel particles with a hydrophobic phase. These particles feature a unique inner structure in which the hydrophobic core is surrounded by a shell of aqueous cellulose hydrogel encapsulated by an outer cellulose layer. Lipases adsorb at the inner oil/hydrogel interface, and LA-producing microorganisms attach to the outer layer. By incorporating cellulytic enzymes, cellulose serves both as a co-stabilizer for the emulsion microparticles and as a glucose source for microbial LA production. Results demonstrating the protective effect of the cellulose-based emulsion system against acid-induced inactivation, as well as evaluation of the enzymatic activity of lipase for LA oligomerization within the aqueous emulsion system utilizing these cellulose-coated microparticles.

Refreshments will be served at 13:15.