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

Tuesday, August 12th, 2025 at 13:30

Room 6

Cellulose-Coated Emulsified Oil Particles as Micro-Reactors

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PhD Seminar

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Concerns about increasing energy demands as fossil fuel reserves are reduced and severe environment concerns encourage the development of renewable alternative raw materials for fuels. One potential alternative to petroleum-based fuels is biodiesel. Our study objective is to convert cellulose from pretreated biomass directly to bio-diesel, using cellulose-coated emulsion micro-particles as micro-reactors for a cascade of biochemical reactions in a "one-pot" consolidated process. Cryogenic-scanning electron microscopy (cryo-SEM) imaging of the micro-particles reveals a unique multi-layer structure: an inner oil core surrounded by a shell composed of a porous cellulose gel which is encapsulated by an external cellulose shell. Integration of cellulose-coated o/w emulsion with yeast (S. cerevisiae) cell exposes a unique self-assembly configuration. This integrated structure exhibited hybridized simultaneous saccharification and fermentation (hSSF) to ethanol. Then, we examine these integrated micro-particles for generation of fatty-acid ethanol ester (FAEE) by lipase-catalyzed transesterification of castor oil at the particle core/shell interface with aqueous ethanol. The activity of lipase-catalyzed transesterification is studied by using ^{1}H NMR quantification of FAEE. Furthermore, it presents a "proof-of-concept" for the crucial step in this process: the ability of lipase integrated within oil-in-water emulsion particles encapsulated by unmodified cellulose, to catalyze transesterification of the encapsulated oil with ethanol dissolved in the aqueous medium. This study presents a novel "one-pot" process transforming cellulose directly to biodiesel by hybridized of cellulose-coated micro-particles incorporating cellulytic enzymes and lipases with yeasts. This consolidated bioprocess of saccharification, fermentation and transesterification (cSFT) promotes effective substrate channeling. It can potentially serve as a model for emulsion-based "one-pot" transformations of cellulose into valuable chemicals.

Refreshments will be served at 13:15.