Department of Materials Science and Engineering Seminar Series 2025

Polymer-Encapsulated Enzyme Nanogels and Their Metal-Ion Coordinated Assemblies for Biomedical Applications

Ma Yedong

Date and time: 19-Nov-2025 4 pm-6 pm

Venue: E2-03-32

Abstract

Enzymes are highly efficient biological catalysts, but their instability and lack of multifunctionality have limited their direct use in biomedical applications. This thesis introduces an integrated strategy to overcome these challenges through the development of polymer-encapsulated enzyme nanogels (SENs) and their metal-ion coordinated assemblies. Using imidazole-functionalized polymer shells, the SENs can coordinate with biocompatible metal ions such as Fe^{3+}, Ag^{+}, and Zn^{2+}, forming dynamic and structurally tunable multi-enzyme assemblies. Building upon this framework, three representative studies are demonstrated.

First, a single-enzyme nanogel system coordinated with iron ions is developed to enable a cascade catalytic reaction that combines starvation and chemodynamic therapy for effective tumor treatment. Second, this strategy is extended to assemble three enzymes into a cooperative network that enhances chronic diabetic wound healing through sequential glucose consumption and oxygen generation. Finally, the concept is expanded to a less explored yet clinically relevant challenge—postoperative wound repair following pancreatic surgery—where a zinc-coordinated tri-enzyme system provides simultaneous antibacterial and tissue-regenerative effects.

Together, these studies establish a versatile and generalizable platform for constructing functional enzyme-based nanomaterials, offering new design principles for catalysis-driven biomedical therapies and broadening the frontier of polymer–enzyme hybrid systems.

Biography

Ma Yedong received her bachelor's degree from South China University of Technology (SCUT). She is currently a Ph.D. candidate in the Department of Materials Science and Engineering at the National University of Singapore, under the supervision of Prof. He Chaobin. Her research focuses on the design of polymer–enzyme hybrid nanomaterials and metal-coordinated assemblies for biomedical applications. Her work aims to develop dynamic and multifunctional enzyme systems for catalytic therapy, antibacterial treatment, and tissue repair.

Please join us!

HOST: Asst Prof Zhong Peichen