Design and Synthesis of Multifunctional Polymers for Amphiphilic Janus Nanoparticle Coating to Form Stimuli-Responsive Vesicle-Like Artificial Membranes

Abstract

The design and synthesis of multifunctional polymeric ligands for coating amphiphilic Janus nanoparticles (JNPs) enable the formation of stimuli-responsive vesicle-like artificial membranes. These bio-inspired vesicles mimic cellular membranes and exhibit controlled self-assembly and selective disassembly in response to tumor-mimicking conditions, making them promising for targeted drug delivery and theranostic applications.

The method involves the synthesis of hydrophilic and hydrophobic polymeric ligands, followed by surface modification of JNPs through ligand exchange, imparting amphiphilic properties essential for vesicle formation. The functionalized JNPs undergo self-assembly in an aqueous medium, forming stable vesicle-like structures. Their size, stability, and morphology will be assessed, and their stimuli-responsive behavior will be evaluated under hypoxic and oxidative conditions, where controlled vesicle disassembly is expected to enhance nanoparticle penetration and delivery.

This project focuses on polymer synthesis, nanoparticle surface engineering, vesicle formation, and structural characterization, contributing to the development of a bio-inspired nanoplatform with stimuli-responsive behavior for advanced biomedical applications.

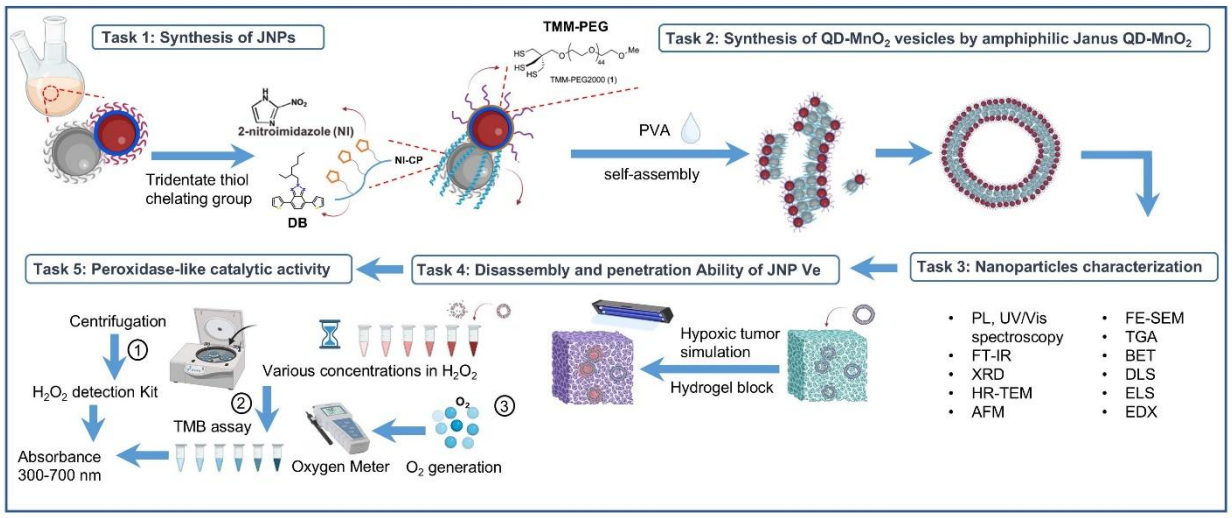

Figure: Summary of the tasks including the main experimental stages (Graphics created using BioRender.com)

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