Indian Institute of Technology Delhi

School of Interdisciplinary Research (SIRe)

SIRe Project Number

2025-01-07

(will be assigned by SIRe)

Project Proposal for Ph.D.

Project Details (The research problem must clearly indicate the need for an interdisciplinary approach)	
Project Title	Fabrication of dual responsive biodegradable polymer-based Janus particles for efficient treatment of cancer
Project Summary (Minimum 500 and maximum 2000 characters)	Stimuli-responsive drug delivery system with desirable on-demand drug release features is postulated to offer great potential in improving therapeutic outcomes in cancer treatment. With the aim of developing a safe and efficient tool for cancer therapy, we propose the construction of dual-responsive biodegradable polymer-based bi-compartmental Janus particles that may demonstrate light and thermo-responsive drug release. One of the compartments of this innovative particle will comprise of acetalated dextran (Ac-DEX, main matrix) loaded with a photoacid generator (PAG), upconversion nanoparticles (UCNP), and an anticancer drug. This particular compartment is designed to exhibit near-infrared (NIR) light-triggered pH-manipulation that will promote drug release upon NIR illumination only. Whereas the other compartment will be composed of biodegradable UCST (Upper critical solution temperature) polymer, superparamagnetic iron oxide nanoparticles (SPIONs), and another anticancer drug. The second compartment will display thermo-responsive drug release as a result of iron nanoparticles-assisted hyperthermia triggered by NIR radiation. This innovative approach will offer physiological stability of the drug carrying particles, safeguard the drugs and regulate their release at the intended site in response to NIR light and temperature change only. Moreover, compartmentalization of two different anticancer drugs may prolong their shelf-life due to avoidance of drug-drug interactions and can be made to release in programmable fashion. To evaluate the therapeutic potential of these particles, we will employ a combination of in vitro and in vivo models. The efficacy and cytotoxicity of the Janus particles will be tested in established cancer cell lines and zebrafish, enabling precise assessment of drug release dynamics, intracellular uptake, and response. We believe this fully biodegradable and biocompatible particles may not only provide the treatment, but also improve the quality of cancer patient's life.

Ph.D. Supervisors
(Supervisor 1 and Supervisor 2 cannot be from the same department of IITD)

Role	Name of Faculty	Academic Unit in IITD/Institute/University	Email ID (Official)
Supervisor 1	Prof. Sampa Saha	DMSE	ssaha@mse.iitd.ac.in;
Supervisor 2	Prof. Shilpi Minocha	KSBS	sminocha@bioschool.iitd.ac.in

Project requirements (Student qualifications, experience required, etc)
***The candidate will be shortlisted based on common shortlisting criteria decided by ScRC (SIRe)**

- Student should have master degree in any one of the disciplines: Chemistry (M.Sc.), Pharmaceutical Sciences (M.Pharma), Polymer science and engineering (MTech./M.Sc) etc.

Source of fellowship/funding and project number
(CSIR/UGC/DBT/ICMR/ICAR/NEET-PG/DST-INSPIRE/IRD/FITT Project details, if any)

Candidate with his/her own fellowship

Role of Faculty Members involved:	
Supervisor-1	Synthesizing polymeric micro/nanoparticles for stimuli responsive drug delivery
Supervisor-2	Assess the performance of the newly developed particles in *in vitro and in vivo* models