Indian Institute of Technology Delhi

School of Interdisciplinary Research (SIRe)

Project Proposal for Ph.D.

SIRe Project Number

2025-01-09

(will be assigned by SIRe)

Project Details	
Project Title	Controlled Polymer- Insulin interaction in the Transdermal Insulin Drug Delivery system
Project Summary (Minimum 500 and maximum 2000 characters)	There is immense potential for the use of the polymeric micron-sized needles for transdermal insulin delivery. The development of clinically feasible polymeric microneedle (MN) based transdermal delivery method has following problems: lack of understading of polymer-insulin interactions leading to inhomogeneous distribution and lack of insulin stabilizing function. This results in a loss of dosage as well as inconsistent insulin release into the body. Insulin also tends to stay in the microneedle and not enter the body due to the retention of insulin within polymeric formulation. The rate of retention depends on the tendency of insulin molecule to bind with the surrounding polymeric material. For the low retention of insulin, the polymer should be moderately repulsive to the insulin. But there should be balance of the repulsive interaction between the polymer and insulin to provide the stability of the insulin. On the otherhand, the polymer should provide sufficiently high compressive strength ofthe MN to pierce the stratum cornea and epidermis. The polymer should allow the interstitial fluid (ISF) to inter inside the microneedle, which can dissolve in the controlled manner. The dissolution of polymeric microneedle inside skin needs to be tuned according to the required dosage of insulin in the body. The proposed plan of research focus on optimization of polymeric microneedle formulation to achieve controlled delivery of insulin in the body. The impact of polymeric microneedle phase behaviour with interstitial bodily fluid imbibition on insulin stability and release will be investigated in depth. The optimised formulation of insulin polymeric material will be used to prepared microneedle using micromoulding technique followed by characterization. The microneedles obtained will be utilised to evaluate the flow dynamics and dosage accuracy of insulin in the microneedle for successful insulin delivery in vitro.

Ph.D. Supervisors

Role	Name of Faculty	Academic Unit in IITD/Institute/University	Email ID (Official)
Supervisor 1	Sudip K Pattanayek	Department of Chemical Engineering	sudip@chemical.iitd.ac.in
Supervisor 2	Sachin Kumar B	Centre for Biomedical Engineering	Sachin.Kumar@cbme.iitd.ac.in

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

- MS/MSc/M.Tech in Chemistry/Biochemical/Biomedical/Bioengineering/Biotechnology
- M.Tech. in any engineering discipline with strong background in Physical Chemistry/ Bioengineering/ Biomedical
- B.E. with GATE qualifications in Biotechnology/Chemical Engineering

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

Project Fellowship

Role of Faculty Members involved:	
Supervisor-1	Guiding the physical chemistry/polymer physics component of project.
Supervisor-2	Guiding the biophysics and biological component of the project