Indian Institute of Technology Delhi

School of Interdisciplinary Research (SIRe)

Project Proposal for Ph.D.

SIRe Project Number

2025-01-32

(will be assigned by SIRe)

Project Details	
Project Title	Investigating Stem Cells Response in Plasma Treated Growth Media
Project Summary (Minimum 500 and maximum 2000 characters)	**Problem going to address:** The intrinsic capability of stem cells to differentiate into multiple cell types can support the regeneration and repair of diseased or damaged tissue and organs. Therefore, their budding applicability in the emerging field of regenerative medicine serves as a promising multifunctional tool for tissue engineering, disease treatments, and other biomedical applications. However, the differentiation and survival of stem cells into specific lineages must be tightly controlled. In this context, growth factors and chemical agents are exclusively employed to stimulate and modulate the differentiation of stem cells, although challenges related to degradation, teratoma occurrence, side effects, and high costs must be overcome. Due to their unique physicochemical and biological properties, the effect of different conditions of growth media have been extensively used to manipulate stem cell growth and differentiation potential. Recently the use of plasma treatment of growth media shows interesting changes in cellular response and its reduced nature by plasma plays a pivotal role in tuning stem cell behavior and their differentiation process. The project aims to develop various plasma processes to achieve the reduction of growth media characteristics for modulating lineage-specific stem cell differentiation. Plasma treatments can be used for the functionalization, reduction through oxidation in oxygen and nitrogen plasma. The effects of plasma treatment depend on the type of ions used and processing conditions, such as plasma power, processing time and temperature, pressure, as well as the location of the samples in the reaction chamber and their distance from the plasma ignition zone. Additionally, zebrafish, known for their transparent embryos and rapid development, provide a unique platform for the study of stem cell differentiation and behavior within a living organism. These experiments encompass a wide array of techniques, including genetic manipulation, live imaging, injury models, and the use of fluorescent reporter lines to explore stem cell responses, regeneration processes, and their applications in regenerative medicine. This multifaceted approach contributes to a comprehensive understanding of stem cell potential, tissue repair mechanisms, and the therapeutic possibilities that stem from such research.

Ph.D. Supervisors

Role	Name of Faculty	Date of Superannuation (DD/MM/YYYY)	Academic Unit in IITD/Institute/University	Email ID (Official)
Supervisor 1	Dr. Marshal	31/08/2042	Physics Department	marshal@iitd.ac.in,
Supervisor 2	Dr. Shilpi Minocha	18/10/2047	Kusuma School of Biological Sciences	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)**

- As per ScRC (SIRe) guidelines
- Preferred students from Plasma physics background with experience in cell culture / life science / medical/biomedical engineering backgrounds.
- M.Tech, Masters, BS-MS in Biological sciences, Biotechnology, Biology with CGPA>7 or 70% with first class in both Bachelors and Masters

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

Role of Faculty Members involved:	
Supervisor-1	Leading to optimization of plasma process for enhancing the physicochemical properties of growth media to modulate lineage specific stem cell differentiation.
Supervisor-2	Prof. Minocha will provide supervision in the areas of Cell Biology, Tissue Regeneration, and the essential utilization of the cell lines and Zebrafish model system required for the project.