



Project Proposal for Ph.D.

Project Details	
Project Title	Investigating Role of Plasma Reduced Graphene Oxide for Stem Cells Differentiation.
Project Summary	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, graphene-based materials have been extensively used as scaffolds to manipulate stem cell growth and differentiation potential. However, the synthesis route of graphene oxide and its reduced form 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 chemically synthesized graphene oxide, enabling them to effectively load and retain biomolecules for modulating lineage-specific stem cell differentiation. Plasma treatments can be used for the functionalization, reduction, and doping of graphene oxide, as well as for obtaining graphene oxide from graphene through oxidation in oxygen plasma and its subsequent reduction to reduced graphene oxide (rGO). 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. Project Summary (Minimum 500 and maximum 2000 characters)

Ph.D. Supervisors			
Role	Name of Faculty	Academic Unit in IITD/Institute/University	Email ID (Official)
Supervisor 1	Dr. Marshal	Physics Department	marshal@iitd.ac.in
Supervisor 2	Dr. Shilpi Minocha	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 assistantship

Role of Faculty Members involved:	
Supervisor-1	Leading to optimization of plasma process for reduction of graphene oxide for enhancing their physicochemical properties 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.