Indian Institute of Technology Delhi

School of Interdisciplinary Research (SIRe)

SIRe Project Number

2024-02-15

Project Proposal for Ph.D.

Project Details	
Project Title	Development and study of Magnetron plasma-controlled functional thin film for Orthopaedic implants
Project Summary (Minimum 500 and maximum 2000 characters)	It is well-known that treating infections in implants is challenging, mainly when biofilms form and can necessitate implant removal and revision in surgeries. The progress in the development of highly porous and rough implants (e.g., nano/micro-thin film-based patterned surfaces, customized 3D printed prostheses, etc.), born to assist implant osseointegration, causes a negative impact on infections. Notably, all the characteristic features that increase cell adhesion to the substrates and, therefore, their differentiation and proliferation ultimately lead to the regeneration of bones, also tend to increase the bacterial adhesion and the events leading to the formation of biofilm and infection. Consequently, the prevention of the infection is a primary goal in orthopedics. This issue can be sorted out by a thin film, which can be able to locally deliver an antibiotic agent in the tuned concentration straightforwardly in the infection site. To prevent infection and facilitate concern-free integration, we propose to fabricate nanostructured bioactive and antibacterial thin films using an advanced plasma-based magnetron sputtering (MS) method. The focus will be made on directly depositing Ag-doped tricalcium phosphate (Ag-TCP) films on medical-grade substrates. The plasma-controlled films' surface morphology, mechanical, and composition will be studied for their biocompatibility. Plasma and radicals will be controlled to tune the properties of the deposited films at various operating conditions. MS method is considered as it was recently demonstrated by the PI's (Dr. Sahu's) collaboration work to produce nanostructured Cu directly at low temperatures by controlling the plasma parameters during the deposition. Additionally, a nanostructured surface can promote host cell adhesion, proliferation, differentiation, and high surface area to guarantee the sustained release of the antibacterial agents. The Co-PI, Dr. Manhas, at the Department of Orthopaedic, AIIMS New Delhi, has been working on Hip and Knee pathologies for more than eight years. He is also treating Orthopaedic infections and doing related research for the last 5 years. Thus, plasma-based nanomaterial will be prepared and studied for their suitability as a biomaterial relevant to bioimplant. The proposed project will be undertaken via a full time JRF student (if found suitable in the interview) using the combined expertise of both PI and Co-PI.

Ph.D. Supervisors

Role	Name of Faculty	Academic Unit in IITD/Institute/University	Email ID (Official)
Supervisor 1	Bibhuti Bhusan Sahu	Department of Energy Science and Engineering, IITD	bbsahu@dese.iitd.ac.in
Supervisor 2	Vikrant Manhas	Department of Orthopaedic, AIIMS	vikrantorthoaiims@gmail.com

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

Qualifications: Master in Physics/Material Science/Bioscience/Biotech/Nanotechnology or MBBS degree, etc.
Experience: Student should have the experience in material science/Bioscience/Biomaterial/Nanoscience, etc.

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	Plasma based deposition process, optimization, material development and analysis
Supervisor-2	Antibacterial and biocompatibility properties of the biomaterial