



Project Proposal for Ph.D.

Project Details (The research problem must clearly indicate the need for an interdisciplinary approach)

Project Title	Designing crack-free and stress-relieved interfaces in refractory alloy – ceramic assembly through intermediate layer engineering
Project Summary (Minimum 500 and maximum 2000 characters)	This project proposes the development of an engineered interfacial design strategy for joining refractory alloys with ceramic coatings such as yttria-stabilized zirconia (YSZ), aimed at enhancing high-temperature stability and structural integrity under aerospace-relevant operating conditions. A novel intermediate metallic layer will be developed and incorporated between the refractory alloy and ceramic coating to mitigate thermal and chemical incompatibilities, thereby improving oxidation resistance, adhesion, and overall durability. The work addresses critical challenges of achieving defect-free, stress-minimized interfaces that ensure reliable performance in extreme environments. Objectives: • Develop and optimize intermediate metallic layers tailored for bonding refractory alloys with YSZ coatings. • Investigate interfacial oxidation kinetics with and without the intermediate layer to establish mechanistic understanding. • Elucidate atomic-scale transport mechanisms across refractory/intermediate/ceramic interfaces. • Optimize joining conditions to obtain crack-free, stress-relieved interfaces. • Perform finite element modeling (FEM) to analyze thermal and mechanical stress distributions at the interfaces. The project’s interdisciplinary nature lies in integrating Materials Engineering and Mechanical Engineering: (i) design and processing of interfacial layers and joining methodologies to ensure robust refractory–ceramic integration, and (ii) modeling-based evaluation of thermo-mechanical stress evolution at the interfaces. The outcomes will provide new insights into processing–microstructure–property relationships of complex metal–ceramic interfaces, enabling reliable high-temperature materials for aerospace applications.

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*	Dr Sangeeta Santra	Department of Materials Science and Engineering	ssantra@mse.iitd.ac.in
Supervisor 2	Dr Abhishek Das	Department of Mechanical Engineering	abhi@mech.iitd.ac.in

*Supervisor 1 must be from IIT, Delhi.
+All cells in this table are mandatory fields that need to be filled by faculty for consideration of proposal.
\$The date of superannuation of supervisors should be at least three years from the date of registration of selected candidates.

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

- Understanding thermo-kinetics of materials
- Exposure on microstructures of materials
- Knowledge of various processing/jointing techniques

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

Full-time Institute Assistantship

Role of Faculty Members involved:	
Supervisor-1	Supervising on the kinetic calculations of the metallic interfaces, interfacial microstructural optimization by correlating with functional, thermal and structural properties.
Supervisor-2	Providing guidance on jointing and bonding processes Providing guidance for modelling and simulation studies

Note :-

- 1. Approval from the respective DRC/CRC/ScRC of your Department/Centre/School will be required for using the "Full-time Institute Assistantship (Category-wise) (FIA)" for selecting the students in SRe.**
- 2. Declaration:- Faculty members, please ensure that you have at least 3 years of service left before superannuation along with adequate sitting space & lab facilities for the SRe student.**
- 3. PI/s are also encouraged to submit joint proposals with AIIMS, NII, JNU and institutes with which IITD has an existing MoU. If the Co-PI (Supervisor 2) is from outside IITD, kindly share his/her detailed CV.**
- 4. If a research scholar is to be considered for selection under the project fellowship, then the project should have a minimum of two-year duration remaining.**
- 5. A candidate applying with a valid JRF/INSPIRE/any national level fellowship should have at least two-year validity from the date of joining the Ph.D. program.**
- 6. The third supervisor’s name (if required) can be added only after the formation of Student Research Committee (SRC) subject to a strong recommendation of SRC and subsequent approval from the competent authority.**
- 7. If Institute fellowship is being sought, then DRC approval of the parent department of Supervisor 1 is required at the time of selection.**