



Project Proposal for Ph.D.

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

Project Title	Development of Sustainable Biopolymer-based Aerogels for Thermal Protective Textiles
Project Summary (Minimum 500 and maximum 2000 characters)	The demand for green thermal insulation materials, such as biopolymer aerogels, has become increasingly important as confronted with escalating environmental concerns and the urgent push toward sustainable practices. In textile industry this field is growing particularly in defense, aerospace, and outdoor protective clothing. Conventional insulators such as foams and synthetic aerogels possess low thermal conductivity as well as density but are non-biodegradable, expensive, less durable or unsuitable for textile incorporation. This project aims to develop biopolymer-based aerogels as a novel, eco-friendly alternative for textile insulation with an emphasis on high flexibility, density, thermal conductivity, wash durability, comfort performance. Various natural polysaccharides like cellulose and chitosan have been explored for aerogel preparation, yet their direct textile application is hindered by poor mechanical robustness, limited wash stability, and lack of flame retardancy. To overcome these challenges, the proposed research will focus on (i) designing crosslinked and hybrid biopolymer aerogels with controlled porosity and enhanced robustness, (ii) employing supercritical CO₂ drying route to enhance porosity and avoid shrinkage during gelation and drying to achieve better results compared to reported research, and (iii) incorporate aerogels into textile structures via different approaches such as in-situ, fiber spinning, coating, and lamination strategies.

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*	Prof. S. Wazed Ali	Department of Textile and Fibre Engineering	wazed@textile.iitd.ac.in
Supervisor 2	Prof. Chinmoy Kumar Hazra	Department of Chemistry	chinmoy@chemistry.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)

- Master degree in chemistry with a specialization in organic chemistry with NET/GATE qualification / M.Tech. in Textile Chemical Processing / Fibre Science / Chemical Engineering / Polymer Science & Engineering
- Candidate with research experience in sol-gel chemistry with a specific focus on aerogel synthesis after post-graduation will be preferred
- Candidate should have know-how on utilization of advanced materials characterization techniques and data analysis

Source of fellowship/funding and project number

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

RP04897G / Candidate with his/her own fellowship or private recognized funding agency.

Role of Faculty Members involved:	
Supervisor-1	Prof. S. Wazed Ali would involve for the development of biopolymer-based aerogels, focusing on material selection. His expertise will support the design of aerogels with controlled porosity, optimized density, and improved robustness. Additionally, he will oversee advanced drying methods, particularly supercritical CO ₂ technique, to ensure high porosity and minimal shrinkage, thereby enhancing the performance and stability of the aerogels compared to existing systems. This supervisor will also lead the incorporation of aerogels into textile structures, exploring in-situ formation, fiber spinning, coating, and lamination approaches to achieve functional and durable textile composites.
Supervisor-2	Expertise of Prof. Chinmoy Kumar Hazra would require for the selection of precursors, crosslinking strategies and hybrid formulations to overcome the challenges of poor mechanical stability. He will also guide for the characterizations of the synthesized materials to meet the practical demands of textile-based thermal insulation.

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 SIRe.**
- 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 SIRe 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.**