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STATEMENT OF PURPOSE

Growing up in an industrialized area near the southern part of India, witnessing big factories and industries was never new to me. Throughout high school, I could visualize the erection of various chemical plants around my home, which provided new employment opportunities to people around the city. However, it did have some potential setbacks. Many residents, including me, fell sick frequently after the set-up of the chemical plant. As a high school student. I wondered what could be the main reason for the city's residents to fall sick regularly and its relation to the chemical industries. That is when I started reading more about chemical plants and their operation. As I delved deeper into it, I began to appreciate the problems associated with the discharge of waste into the water bodies and its potential hazards to aquatic life and humankind. Being known only about the presence of salt in the water till that time, the contamination of the water bodies with different waste was shocking. With more readings and discussions with my school teacher, I understood how to identify and quantify the various pollutants in water bodies. Post my excellent performance in high school, I was admitted to the National Institute of Technology, Tiruchirappalli, in Chemical Engineering, which enabled me to explore my passion for solving societal problems.

As a freshman at the university, I was exposed to the present research scenario in different energy alternatives. To gain practical knowledge, I worked on "Single module flow electrode effective capacitive deionization for continuous water desalination" at Anna University. Here, I learned about the capacitive-deionization processes desalination efficiency and received hands-on training to synthesize the different forms of carbon material from biomass waste for the flow electrode. This project showed me how different materials influenced the water desalination process. To better understand the concept of material design, I chose two courses offered in Material Science and Technology, Renewable Energy. These courses intrigued me further to understand the significant influence of the material's structure-property relationship in various applications. Hence, in my sophomore year, I pursued a project on Polymer Electrolyte Fuel Cells at CSIR-CECRI, Madras Unit, for two months. During this project, I developed various bipolar plate materials with reduced weight, increased mechanical strength, and reduced corrosion in the metallic bipolar plate. I also worked on catalyst preparation and MEA fabrication and experimented with the fuel cell to optimize 2-3 different parameters, drastically increasing its performance. This project was awarded an S grade (top 10% of students) when presented at my institute.

It was an eye-opening project to understand and visualize how materials are a roadblock in developing efficient technologies. To understand how the material changes the phenomenon's expected outcome, I enrolled in various online and elective courses across multiple departments at my institute like "Structural Analysis of Nanomaterials" (conducted by IIT Roorkee, secured the top 2% of the certified candidates), Nanomaterials and Applications. Enriched by these experiences in the past, I was inquisitive to explore more about materials chemistry. I converted my assignment in the "Energy Storage Materials" course into a project to evaluate the performance of biomass-derived hard carbons as an electrode material. I was thrilled upon getting selected for the three summer research fellowship at the ICPEES, the University of Strasbourg in France, on "Synthesis and the electrochemical studies of the few-layer graphene supported metal oxides/nitrides". However, the pandemic significantly setback me in pursuing my internship in

France. I secured an online internship on the "Macronization of graphene materials and other 2D materials for practical applications". In this project, I have finished writing a review article on the dimensional modelling of graphene material for various novel applications, including, but not limited to, energy storage and electronic applications. This topic of study changed my view on the prospect of bringing nanomaterial properties into macro-scale materials through novel synthesis techniques.

This project provided a pathway for me to understand how the material's chemistry was the main reason behind the behaviour of various classes of materials. The internship experience at NUS opened up two new scientific domains on metal-organic frameworks and nano-plastics. Here, I was exposed towards developing novel metal-organic frameworks as an adsorbent for removing nano-plastics and learnt various special characterization techniques. I have two research publications under preparation; one has been submitted from this internship. With continuous exposure to electrochemical technologies and sensing applications, I understood the importance of sensors in different applications and how quantification will majorly help develop health and environmental policies. With this aim, I lead the project on the MXene hydrogel system through simple one-pot techniques using cross-linkers as electrodes for supercapacitors which can be ultimately used in biosensor applications.

As my ambition and passion for becoming a pioneer in materials science grew, I understood that building strong content knowledge and technical expertise in material chemistry would help me design the material with suitable properties while working on diverse applications. During my PhD, I would like to work on re-engineering or developing novel materials and understand their behavioural mechanism in bioelectronics devices. Post my graduate study, I want to work in R&D organizations, where I seek to understand the designing and technical upgradation required for translating lab-scale research on bio-electronics to the commercial markets. In the next ten years, I see myself as a material scientist working to formulate the design and development of low-cost, novel materials for improving the state of the art of biosensors. Thus, I see this PhD opportunity in the collaboration between the IITKGP-University of Manchester program as an excellent opportunity for me to explore biosensors and healthcare applications. The interdisciplinary nature of the research work makes me deeply interested in applying for this project on "2D material ink for printed biosensor and point of care applications".