Statement of Purpose

The hard-metals industry relies on sintering as one of its manufacturing steps, but the additive manufacturing benefits of tool-free production, new and unique shapes, innovative and functionally graded materials and, part customization are inevitably attractive. With an ardent desire to contribute to the development of this exciting field, I seek to apply as a student to obtain my doctorate degree. My long-term aspiration is to conduct extensive research and contribute to the steady onward march of progress in material development and manufacturing technologies which will take steps to solve the first world problems, and I believe that the **Indian Institute of Technology Kharagpur** and the **University of Manchester**, with its state-of-the-art research facilities and dedicated laboratories working specifically in my area of interest, will best help me fulfill my dream of leading new materials and manufacturing revolution.

During my undergraduate, I was introduced to the emerging field in manufacturing technologies of additive manufacturing by **Dr. Sibhendu Sekhar Roy** at the **National Institute of Technology Durgapur**. Besides theoretical understanding, I had hands-on experience in making parts for robotic competitions, which boosted my motivation in this technology. In my post-graduate studies, I have the privilege of pursuing interests in **laser-based additive manufacturing** at the Advanced Manufacturing Technologies Lab of **Indian Institute of Technology Ropar**, under the supervision of **Dr. Anupam Agrawal.** Most of the simulation models for additive manufacturing are high-fidelity but expensive in computational resources and not particularly generalizable. Addressing this gap, my research involves developing predictive computational models for **Selective Laser Melting,** which consists of an algorithm comprising a semi-analytical solution for volumetric moving heat source followed by numerical formulations for conduction-convection cooling, to predict the temperature distributions and melt-pool geometry in the part's manufacturing. Fully implicit Finite Volume equations are framed with appropriate part boundary conditions for two-dimensional domain and solved iteratively by Alternating Direction Implicit (ADI) method in MATLAB. The work is then extended to simulate layer-by-layer single-scan deposition and prediction of residual stresses. The research has been accepted for conference publication, entitled **Prediction of melt-pool characteristics in SLM process for Ti6Al4V alloy** at the **Manufacturing Science and Engineering Conference – ASME, University of Cincinnati, USA, 2021.**

My undergraduate course on **Material Science** enabled me to clear fundamentals on unit cells, imperfections and dislocations. I felt the need to refine the attained knowledge further, hence undertook the course of **Solidification Processing** at IIT Ropar, which covered topics like thermodynamics of single and multi-component systems, nucleation, grain growth, phase diagrams, and heat treatment. I am closely associated with a project in our lab which deals with the development of **Functionally Graded Materials** made of, Titanium alloy and Hydroxyapatite for bio-medical applications. I assisted in the fabrication of specimens of varying compositions by sintering and characterization by Scanning Electron Microscopy and Energy Dispersive X-Ray Spectroscopy.

My research interests strongly coincide with the domains related to the project **Development of novel metal/ceramic composites via laser-assisted additive manufacturing processing for advanced surface engineering applications**. My present research and manufacturing-specialization courses have inevitably intertwined with the study of the microstructure, which motivates me to delve into a work that encompasses both fields. There is a duality between material and structure and additive manufacturing helps to couple these two, and I believe my background in this technology along with the co-operation from research groups from both the institutes, I shall prove to be a valuable asset and propel the project to success. I have also had a brief discussion with **Dr. Siddhartha Roy** regarding the objectives, and I feel that I can best pursue my research interests working for this project.

Being consistently involved in research activities, I have a good insight of the challenges and difficulties of coping with strict deadlines and temporary failures, especially in the current Covid situation. My stint as a graduate researcher has inculcated various essential skills such as CAD, modeling, programming, experimentation, and control. The opportunity to work on my area of interest will help me use my experience and utilize my skills to the full potential. After completing my doctorate, I plan to use my knowledge to help educate fellow professionals and improve our sector's awareness and understanding. I crave for a holistic development that would shape me as a better person, and I believe that IIT Kharagpur and the University of Manchester will undoubtedly be a cornerstone in quantifying myself as a research scientist a probable professional.