

## STATEMENT OF PURPOSE

Working hard to achieve my goals has been my motto from the very beginning. This passion helped me secure a place among the top 0.64% of 0.4 million IIT-JEE aspirants, hence unlocking doors to one of the best engineering colleges, the Indian Institute of Technology Madras. I am currently pursuing B.Tech in Chemical Engineering. At the time of matriculation, based on overall performance in JEE exam I was allotted Civil engineering. During the first semester of the program I realized that my interests aligned more closely with Chemical engineering and I decided to try for change of major to Chemical Engineering. My hard work and enthusiasm for the subject helped me change the major after the first semester, an opportunity given to top 5% students of the branch. It is my long term goal to pursue a research career in chemical engineering and I feel that pursuing graduate studies at a reputed school will help me prepare for such a career. In particular, I want to work in the field of nanoengineering and polymer science and contribute to society through technological innovation.

Chemical Engineering appeals to me because of its potential to address present day engineering challenges such as pollution and energy crisis, design of environment friendly and economic waste treatment techniques, drug discovery for treatment of incurable diseases and synthesis of recyclable materials. My continued interest in the field has spurred me to do well in undergraduate curriculum and I currently rank within top 10% of my class.

I am excited about pursuing PhD in Chemical Engineering at the North Carolina State University. I have read about the related research at your department in these areas and understand that the department conducts research which is directly relevant to my field of interest and will provide the pathway for achieving my long-term goal. Various groups like that of Prof. Michael Flickinger and Prof. Michael Dickey work in areas of nanostructured materials, smart material, polymer science which interests me. The access to cutting edge facilities, interaction with renowned faculty at your institution will help me develop my knowledge and versatility.

I have significant research experience in my areas of interest. In the field of nanotechnology, I have worked on a research project at the Max Planck Institute for Colloids and Interfaces (MPIKG) as a DAAD-IAESTE scholar during summer 2011. The project was supervised by Dr. Skorb and Prof. Möhwald (*Director of MPIKG*). The goal of the project was to develop synthesis techniques for formation of porous Mg-polypyrrole hybrids which can be ultimately used as capsule for drugs or other useful chemicals. The formed capsules can help overcome inefficiency in existing drug delivery techniques and can ensure targeted and controlled delivery due to their response to electrostatic stimulus. The additional objectives of the project were to examine the effect of pH variation on release of Rh-6G, 8-hydroxyquinoline from Mg capsules and formation of surface-active polypyrrole coatings on magnesium plates.

I investigated the effect of variation of multiple reaction parameters on formation of hybrids and coatings and came up with an efficient synthesis technique. The technique was appreciated by Dr. Skorb and I was given the opportunity to present my results in a poster presentation during the Alumni Meet at MPIKG on 24<sup>th</sup> June 2011. The meet was attended by leading scientists from around the world. I am currently working on a journal publication based on my research. The article will be submitted to the Journal Of Material Chemistry in December 2011.

During the fifth semester, I worked on a project on alumina nanoparticle fabrication by sonofragmentation under the supervision of Prof. Nagarajan (Department of Chemical Engg., IIT Madras). The goal of the project was to develop novel techniques for mass production of alumina nanoparticles by common synthesis routes. In the initial stages, I built and worked on a batch reactor setup with provision of recycling layers of larger particles. After encouraging results, I came up with an idea to investigate the combined effect of flow of media and ultrasound on particle fragmentation. I designed a tubular reactor to carry out the experiments which helped me to obtain optimum reactor conditions. Literature survey enhanced my knowledge of various synthesis techniques for nanoparticles and their potential applications in films, coatings and curing diseases such as cancer.

As a part of my B.Tech. project, I am currently working with Prof. R. Nagarajan on the formation of stable zinc oxide nano suspensions. The goal is to devise a technique to obtain uniform particle size distribution in nanoscale range. As part of ongoing research, I am analyzing the effects of various parameters such as loading of metal powder, vapour pressure, frequency, power and type of sonication technique on sonofragmentation. I have been investigating industrial application of my work and am currently collaborating on a project with engineers at Coromandel fertilizers (Muruguppa Group, Vishakapatnam). The collaboration aims to address the problem of zinc depletion from soil in India. Based on my research, I have proposed a technique to help address the problem. My proposed technique has the advantage that it can be readily incorporated in the existing plant model. The preliminary results from the research will be presented as a conference paper in **8<sup>th</sup> International Symposium on Cavitation CAV 2012**.

Besides the previously described projects, I have also investigated several problems of interest as part of course projects. In an introductory course on polymer science, I wrote a term paper on gas desulphurization using membranes which acquainted me to the role of polymers in pollution treatment. Based on the performance in the paper, I was evaluated as the best student in the class. As part of a lab course on molecular operations, I studied rheological behavior of commercial shampoos to fabricate a product with improved functionality. The course on chemical reaction engineering gave me the opportunity to work on design of low pressure Gallium Arsenide CVD reactor using software tools such as Gambit, Fluent and COMSOL. The projects have helped me broaden my understanding of chemical engineering and also given me the opportunity to learn about useful scientific techniques such as XRD, Zeta potential, Particle size analyzer, SEM, TEM, AFM, contact angle measurements, etc.

To gain industrial experience in Chemical Engineering, I interned at Hindustan Zinc Limited(HZL), Chanderiya (Rajasthan, India) in summers of 2010. HZL is the 5<sup>th</sup> largest producer of Zinc in the world. I gained exposure to an industrial set up which enabled me to understand methods of research from an industrial perspective as well. I worked on a project in the sulphuric acid production unit on designing an assembly of stainless steel shell and tube heat exchanger to reduce corrosion problems due to vapors of SO<sub>3</sub>. My work has led to improvements in efficiency and cost reduction of heat exchanger.

As part of undergraduate course curriculum, I have taken several courses relevant to chemical engineering and my areas of interest. Besides the core courses in mathematics, physics and chemistry, I have taken courses related to momentum transfer, mass transfer, heat transfer, transport phenomena, mechanical operations, process control and chemical reaction engineering. The theoretical component in each of the courses has strengthened my fundamentals and the associated lab component has helped me gain hands-on experience of designing and conducting experiments. In addition to these, I have also taken courses related to study of macromolecules, semiconductor manufacturing processes and chemical vapor deposition techniques.

My undergraduate life in college has given me the opportunity to develop my interpersonal skills through participation in various team activities. I was the sales coordinator for our ISO certified festivals Shaastra and Saarang for the year 2010-11. As part of the Environment Conscious group, I got the opportunity to work for social cause. I was also an active member in the school soccer team, and my contribution as midfielder helped the team to win the district cup. I believe that my ability to collaborate and coordinate well in a team environment will help me in graduate school.

I am passionate about exploring the field of nanotechnology and polymer science and have prepared myself throughout my undergraduate life through projects and course work. Being a part of your programme will help me achieve expertise in my areas of interest. I understand that North Carolina State University demands a strong commitment from its students. My strengths are research experience, strong grasp of theory, ability to work in a result oriented fashion. It is my interest and passion to make my dreams a reality and I am confident that I can meet the high standards set by your university. I thank the committee for their time and request to favorably consider my application.

**Ankit Goyal**