# STATEMENT OF PURPOSE

YE SEO PARK(yseo@udel.edu) MATERIAL SCIENCE AND ENGINEERING

My father was a man who really loved nature, which makes my values of always being eagerly interested in environmental affairs with a passion for animals and green welfare. Growing up under my father's influence and traveling around the world, I have encountered many different aspects of nature throughout a range of diverse regions and, no matter where I go, I always feel a sense of unity with nature. Whenever I am in nature, I am reminded of a statement I heard in a summer school program I was part of when I lived in New York: "The environment can eventually be restored to its another state." During this program, I worked on a small project on the recycling of plastic bottle caps, which culminated in my team and I using plastic bottle caps to make road signs. This was just a small play with the children's level, but it was definitely in the back of my mind and made my eyes open to green chemistry.

Living in faraway China and the U.S for each consecutive year, I did learn some lessons from diverse cultural environments, and it was such an irreplaceable time in which I used to get along with people having different concepts of cultural, social, or independent values who were from each far away and who made me break my little silly stereotypes and respect their difference which in fact, were not different from me. They were from far away abroad as Mongolia, Chinese, Spain, American, and so on, with them, I got several teamwork projects such as every morning national gymnastics and joint performance with the flute, trumpet, cello, and cymbals in China, or science team projects and open reading discussion with active participation in the U.S. There, I could establish my personality and values experiencing what our country doesn't have; I have never seen learning cooperative attitude from in-touch diverse learning and independence, open-minded behavior in multicultural society before.

Since back to Korea, I unwillingly had to concentrate on cramming studying due to the highly-fevered education system, which I rather wanted to learn in-touch education. It gave my passions disappearing, and with a lack of test scores, I had no choice but to go to an unwanted major, all of which was opposite to my interests. Until young, I was unfamiliar that chemistry might be further from nature which I believed real natural science. As soon as I realized that was my misunderstanding when I took chemistry courses and animal genetics majoring in Animal Resources Science, I recognized that the natural world is much more complicated than I had originally thought; I began to view chemistry which is a transcendent complication of chemical reactions and applied development for green chemistry. In addition, learning about biochemistry and organic chemistry, subjects I had never encountered, my passion for the relationships between chemicals was piqued and I began to wonder about the role those chemical properties play when grafted by bio-based materials. Moreover, the environments, in which my father and I often discussed engineering polymers of which his company made automotive parts for their superior mechanical and thermodynamic properties, gave me a new spotlight to move on to my second life.

Inha University, my new alma mater, is one of the most renowned engineering schools in Korea, where I successfully transferred to chemical engineering. This motivation for chemical engineering facilitates me to overcome the difficulty of moving to another university which I wanted. Even though that challenge might risk a big failure within a year, I could achieve my goal of transferring to chemical engineering and it was the most invaluable experience in my overall life. With infinite confidence, I eagerly participated in my first engineering design course during these studies, where my team and I worked with dedication on a project of our own design. We could create a benign polyurea aerogel, a kind of new material that is composed of mostly air with super-low density, and my team then simulated it as a 3D drawing of a silent vacuum cleaner on an industrial scale, where the aerogel we had created was incorporated as lightweight and soundproofing submaterial of the vacuum cleaner for resolving inter-floor noise which is a most serious problem within the neighbors in Korea, finally reaching our team won second prize. Building this achievable experience became a passion of mine and I wanted to extend exposure to other chemical engineering programs, even though I never thought this would be something I would pursue near future. Following this realization, I participated in a public creative design contest for all Korean undergraduates at "The Korean Institute of Chemical Engineers". It was for "eco-friendly daily necessities", but all of the ideas have been too cliched. While searching for new ideas, what flashed into my brain was crustacean garbage which accounts for the biggest marine environmental problems and found that it can be converted with

chitosan for biodegradable products. From starting to make chitosan from crustacean garbage to analyzing with Nuclear Magnetic Resonances and tensile strength tests, we successfully made a biodegradable chitosan film, with better tensile strengths compared to currently used vinyl wrap and plastic bags, an awarded result of our encouragement prize.

Despite lots of trial and error in these projects, I felt my first leadership here as an enthusiastic leader by synthesizing these eco-friendly substances, creating reports and structured content, and presenting our projects. However, I still needed more knowledge and learning of experimental skills and theoretical analysis, and this aroused my willingness to continue more research in the path of Polymer Nanomaterials Lab. While enjoying my research as a master's student, our laboratory burnt down which caused me to pull the plug on all research and begin to set up from the beginning. Plus, I carried out several missions to re-set up the perfect laboratory in the duty of my position like listing up the equipment and laboratory supplies we've had before, investigating the placement of relocation where to go, or budgeting for reconstruction and research. This was the second time when I showed my leadership with a great deal of responsibility and the success of setting up the laboratory from scratch gave me another part of inspiration to research. By acquiring these versatile capabilities, I want to be a well-directing leader who has mutual respect and a sense of ownership all the time.

In the chance to lead the 'Aerogel Materials Research Project' in the Polymer Nanomaterials Laboratory, I learned how to fabricate polymethylsilsesquioxane aerogel and how it can be formed through sol-gel chemistry with hydrolytic condensation. I was able to design more sophisticated experimental methods for making the aerogels giving the variables, differentiating the kinetics of hydrolytic condensation, and analyzing their structures like better tensile strength or hydrophobicity. With an idea of imparting flame retardant properties to the aerogel with a novel environmentally friendly flame retardant material named DOPO, which doesn't emit any halogen elements and can also show unique flame retardant mechanisms in the gas and condensed phases simultaneously due to the synergistic effect Si and P elements, I could synthesize DOPO-derivative polymethylsilsesquioxane aerogel monolith showing 60 % reduced heat release rate. Besides this, I tried to fabricate an organic-inorganic hybrid aerogel monolith by adding chitosan as an eco-friendly biodegradable flame retardancy, the material with which I had previously used in the undergraduate project.

Being able to a continual part in my master's degree at the University of Pittsburgh, I enhanced my English proficiency and focused on bioengineering, particularly antibacterial nanomaterials, and Joint-on-a-chip technology. As a summer research assistant at Carnegie Mellon University, I led a project on crystalline $TiO_2$/SWCNT aerogels for antibacterial applications, developing photocatalytic materials that are active under visible light, targeting that these aerogels exhibit excellent antibacterial properties due to their enhanced photocatalytic activity and ROS generation. I synthesized, characterized, and tested these aerogels for crystallization and antibacterial efficacy, deepening my knowledge of nanomaterials and reinforcing my commitment to sustainable solutions for global health challenges. I am eager to explore the potential of functionalized hydrogels and aerogels in the Department of Material Science and Engineering at Carnegie Mellon, aiming to design innovative materials for nanotechnology applications. In the long term, I aspire to be a leader and engineer whose research enriches academia and society, leveraging the expertise I will gain from a Ph.D. at your institution.