Originating from my hometown, Shanxi, a region renowned for its abundant coal mines, I am acutely aware of the environmental challenges accompanying such prosperity. The significant coal mining activities and subsequent coal combustion in the area have precipitated severe environmental issues. I vividly recall days when the air pollution index soared off the chart and witnessed friends grappling with pneumonia. Back then, I learned that Chemical Engineering plays a pivotal role in addressing such pressing issues, and this realization fueled my initial passion for the major. This fervor was further fueled when recent wildfires in Canada painted the skies orange and filled the air with pungent odors, invoking memories of my childhood. The juxtaposition of those recollections against the present reality solidified my unwavering commitment to dedicating my career to chemical engineering. My academic journey, from undergraduate studies to master's research experiences, has been firmly rooted in these concerns, propelling me toward the next step in my academic pursuit. To this end, I am deeply motivated to apply for the Ph.D. program in Chemical Engineering at Columbia University, where I aspire to continue my research under the guidance of Prof. Kumar, with a focus on developing commercially viable nanoparticle-based membranes in the air purification sector that boast outstanding performance and are economically practical.

With curiosity and desire to address the problems that concerned me, I deemed that exploring the intrinsic properties of substances themselves was essential. This led me to pursue a chemistry major in my undergraduate studies. This intellectual curiosity pushed me to a point where I was in the top 10% of students at Shanghai Jiao Tong University, I had the privilege of being admitted to the Zhiyuan Honors Program. This program's rigorous emphasis on foundational sciences provided me with a robust mathematical and scientific foundation. Concurrently, I delved into organic chemistry, physical chemistry, and polymer chemistry, immersing myself in these domains.

Beyond the realm of academic study, I was determined to gain experience as a researcher in laboratories as early as possible. Consequently, toward the conclusion of my freshman year, I had

the privilege of joining the SJTU Qiu Group, specializing in Precision Hierarchical Self-Assembly. After undergoing over 100 hours of training in research methodologies and experimental techniques, I embarked on my journey in polymer science research under the esteemed guidance of Prof. Huibin Qiu. In my first literature review research titled "A Self-Assembly Pathway to Soft-matter Toroidal Nanostructures," I provided an overview of toroidal nanostructure preparation, with a particular focus on the evolving self-assembly routes of soft materials. This hands-on involvement in polymer science, coupled with my profound interest in refining materials and integrating superior alternatives into industrial production, solidified my commitment to research in polymer nanocomposites and nurtured my aspiration to cultivate skills capable of translating innovative concepts into substantive research projects.

Expanding my research horizons, I applied to the Zhiyuan Scholars Research Program. As the team leader, I independently formulated and presented the project proposal. Standing out among 50 research groups, we secured a project grant of 75,000 RMB for two years. Our objective was to pioneer nano-horticulture using poly(lactide) (PLLA) containing micellar brushes, leveraging the biocompatibility of PLLA for applications in biomedical domains such as antibacterial measures and cellular screening. Throughout this intricate journey, I significantly honed my practical skills. I employed an array of characterization tools, ranging from NMR, MALDI-TOF-MS, and GPC for determining the optimal polymerization degree of PLLA, to utilizing TEM and SEM for visualizing micelle morphology, whether in solution or on material surfaces. Furthermore, the project cultivated my inventive spirit, compelling me to design a myriad of experiments to unravel the assembly dynamics of block copolymers in solution.

My studies and research provided me with a solid chemistry foundational theory and practical skills for crafting high-performance polymer materials. Yet, a gap exists between laboratory studies and industrial use. This spurred my pursuit of Chemical Engineering at Columbia University for a master's, enhancing engineering theories and computational chemistry for predicting material

properties. Simultaneously, my dedication to addressing air purification and my profound interest in polymer nanocomposites and gas transport drove me to seek further advancement in my research pursuits. I became a part of Prof. Sanat K. Kumar's lab, investigating the impact of polyoligoanilines inclusion in poly (methyl acrylate) (PMA) containing graft nanoparticles (GNPs). Rheological measurements using small amplitude oscillatory shear (SAOS) were performed on the system. It was determined that modifying polyoligoanilines placement within GNPs indicated a huge impact on mechanical properties. My ongoing research primarily centers around the thorough exploration of the mechanical and gas transport characteristics of GNPs while incorporating varying proportions of free chains. Our objective rests upon the determination of the activation energy governing diverse gas permeabilities within discrete GNP membranes. This multifaceted endeavor combines meticulous experimentation with insightful analysis, aiming to uncover the intricate mechanisms through which free chains exert their influence on the gas permeability of GNP membranes.

During my tenure in Prof. Kumar's laboratory, I not only acquired an extensive repertoire of characterization techniques for diverse properties of polymer films but also developed a keen ability to comprehend the inner workings of instruments in an engineering capacity. This journey encompassed grasping the design principles underpinning instruments such as gas permeation cells, and progressing toward the conceptualization and construction of setups for characterization. This learning extended beyond mere material characterization methods, delving into the realm of process engineering. This dimension of growth significantly appeals to me, marking a pivotal highlight in my academic journey.

My continuous learning journey has led me to recognize the substantial potential of polymer nanocomposite membranes in applications concerning air purification and gas separation. Fueled by this realization, my aspirations drive me to pursue further research endeavors. Consequently, I'm enthusiastic about seeking admission to the Ph.D. program in Chemical Engineering at

Columbia University. My goal is to further investigate gas transport phenomena under the adept guidance of Prof. Kumar. Should I be granted the privilege of embarking on a Ph.D. journey, my forthcoming research will pivot toward the understanding of gas transport mechanisms. One of the avenues is to do high-pressure conditioning of membranes crafted from GNPs. This pursuit involves probing the mechanisms through which increased pressure heightens gas permeability and scrutinizing the enduring impact of this treatment.

In closing, I wish to express my heartfelt appreciation for your meticulous consideration. This promises to be an enthralling and profoundly significant pursuit, one that I eagerly anticipate undertaking.