[redacted]**– Personal, Background and Future Goals Statement**

As a first-generation, non-traditional student, the path I took to discover my interest in research was more circuitous than it is for most. Both of my parents, along with my younger sister, suffer from inherited health conditions that left them disabled, and my responsibilities as their primary caretaker forced me to withdraw from college after only one semester for financial reasons. While I regretted this decision, it encouraged me to confront the health issues that left my family in need. After helping my family to regain our financial stability by working full-time, I re-enrolled at The University of Southern Mississippi (USM) with the intention of studying a field of science where I could contribute to wearable medical devices that might make an impact in the lives of the people dearest to me. I felt confident that studying polymer science and engineering would provide me with the knowledge and experience that I needed to meet my goals. When Dr. Xiaodan Gu (a researcher and professor of polymer physics) gave a guest lecture in my freshman polymer science class, he discussed flexible polymeric materials that could improve the quality of life for people like my family members by blending seamlessly with human skin and detecting hidden health conditions. After joining Dr. Gu's research group and beginning to explore how polymers can be functionalized to serve in bioelectronic applications, my passion for research in polymer science was ignited! For the entirety of my undergraduate career, this passion has governed my research experiences and has shaped my decision to pursue a Ph.D. in chemical engineering and an academic career as a research professor and principal investigator in the field of organic polymer electronics.

Intellectual Merit

In my freshman year, after working only two weeks in the Gu Group, I was tasked with learning the daunting operation of small/wide-angle X-ray scattering (SAXS/WAXS) instrumentation so that I could train new users and contribute to a collaborative project with scientists at Peking University. After testing several diketopyrrolopyrrole (DPP) based polymer samples via this technique, the data that I generated aided my fellow contributors in proving that the conjugated polymer they synthesized demonstrates closer π-π stacking, higher electron mobility, and higher electrical conductivity than previously seen in these types of materials. These findings resulted in my first co-authored publication (*J. Am. Chem. Soc*. **2019**, *141*, 51, 20215), but more importantly, this experience catalyzed my burgeoning interest in conjugated polymers and their ability to form flexible electronic devices. Following this study, I was asked by my research advisor to serve as the **sole undergraduate in charge of the SAXS/WAXS instrument.** Since few institutions in the Southeastern U.S. own a SAXS/WAXS instrument, this role granted me the unique opportunity as an undergraduate to train graduate students and faculty members and has also placed me at the forefront of several collaborations with professionals in academia and industry. Soon, my research experiences preponderated any disadvantage my delayed start in academia could have posed as I became more confident in performing experiments and presenting their results.

In my next project (a joint effort with scientists at Jackson State University), I sought to help address the small device size and narrow operation windows that limit the applications for perovskite films prepared by anti-solvent assisted spin-coating. It was my responsibility to study the preferred crystal growth orientation for perovskite films. I performed X-ray scattering on thin film samples to investigate inhomogeneous intensity distribution of scattered rings. My analysis aided in confirming the reproducibility of highly crystalline perovskite films synthesized at Jackson State University. The results of this project suggested that the spontaneously supersaturated nucleation approach held great potential in the application of scalable solution processing techniques and resulted in another co-authored publication (*Chem. Eng. J.* **2021**, *405*, 126998).

Through my collaborative research efforts at USM, I have had the privilege of co-authoring **five peer-reviewed publications that have garnered 92 total citations thus far**, with three additional manuscripts pending publication. Of the five published articles, three were published in high-impact journals (impact factor > 10). I have also had the opportunity to present my research at three regional

conferences, *winning 1st place in two of them*. In recognition of my dedication to research endeavors, The USM School of Polymer Science and Engineering recently selected me as the **sole undergraduate representative** for an NSF site visit, where I delivered a three-minute thesis-style presentation of my work as it related to a grant we received from NSF. During this site visit, one of the panelists, Dr. Silvana Andreescu, suggested I apply for the NSF Graduate Research Fellowship Program, stating that I might be a competitive applicant for some of the premier research universities in the U.S. Additionally, I was recently honored with the **Barry M. Goldwater Scholarship** which is a highly prestigious and nationally competitive scholarship that aims to support students who show exceptional promise of becoming America's next generation of research leaders. I plan to continue embodying the principles that these acknowledgments represent as I turn my attention towards graduate research. I am particularly interested in contributing to the widespread commercialization of robust flexible bioelectronics by investigating how blend systems of partially and fully conjugated polymers can be optimized in wearable biomimetic devices.

USM has prepared me for my goal of pursuing a Ph.D. in chemical engineering by providing **a unique education in polymer organic chemistry and molecular thermodynamics**. This rigorous plan of study, coupled with my 20 hours per week in the laboratory working alongside graduate students, has helped me develop graduate-level research, writing, and presentation skills, while also encouraging networking and collaboration with researchers from different educational institutions and from industry. Through the professional network I began building, I secured a summer research internship after COVID-19 disrupted my earlier plan to pursue a research experience for undergraduates (REU) at an academic institution. I previously connected with engineers at the chemical engineering company, Heritage Plastics, Inc., and after speaking with their project director, **I was offered a paid internship**. Since most universities halted REU opportunities for the summer, this opportunity served as a means for me to gain industrial experience while solving problems by applying the techniques I had previously learned in my research lab. While I do not intend to pursue an industrial career after completing my graduate education, I was fortunate to have an opportunity to supplement my knowledge of material scale-up and production over a summer that was deeply affected by the COVID-19 pandemic. This experience also exposed me to the advantages of roll-to-roll processing which offers the most streamlined means of production for my primary research interest of flexible electronic devices.

The following summer, **I successfully secured a position as a research intern** at The University of Massachusetts Amherst in the Department of Polymer Science and Engineering. Under the tutelage of Dr. Reika Katsumata, **I led an independent research project** involving the de-wetting behavior of bilayer polymer systems. After learning that de-wetting behavior has been examined for thin polystyrene films on a silicon substrate, but that little information is available for polymer/polymer interfaces, I worked on developing a comprehensive suite of bi-layer and tri-layer polymer systems consisting of polystyrene and polymethylmethacrylate to elucidate their de-wetting patterns. These multi-layered polymer systems were designed to decrease the effect of a silicon substrate on the interfacial forces of the films so that the individual contributions of each polymer at the interface could be identified. This experience expanded my understanding of the interfacial behavior of thin films, which strengthened my overall knowledge of the components in wearable electronics. As semiconductor devices are often created by the deposition of multiple thin films, understanding de-wetting conditions will allow me to design stable lithographic resists by predicting stability conditions and preventing de-wetting from occurring.

Broader Impacts

Throughout my time as an undergraduate researcher, I have actively sought opportunities to augment my professional development by dedicating my free time to supporting other young scientists in their research pursuits. As president of the USM Polymer Science Association, a student organization that actively encourages student retention and participation in research, **I began several**

new initiatives that included a Diversity and Inclusion Committee and a mentorship program. The creation of the Diversity and Inclusion Committee was inspired by my participation in the **Ronald E. McNair Scholars Program**, which provides research opportunities that promote the attainment of Ph.D. degrees by underrepresented students in academia. Working with other students in the McNair Scholars Program encouraged me to tackle the unique challenges that underrepresented students face in their first years attending college. Through The Diversity and Inclusion Committee, I strive to help underrepresented students find appropriate scholarship aid and research experiences, such as work-study opportunities and REU programs specifically designed for minority students. The mentorship program I initiated pairs each incoming freshman to the School of Polymer Science and Engineering with a junior or senior that can serve as a mentor and friend in the early stages of each student's academic journey. This program has become an integral part of the undergraduate experience since its introduction and has served as a model for other undergraduate organizations at USM.

Additionally, I currently serve as the **primary mentor** for a sophomore undergraduate in the Gu group where I oversee his research progress and train him in characterization techniques such as atomic force microscopy and X-ray scattering. Since my professional goals were strongly supported by Dr. Gu's mentorship, I have a passion for serving as a mentor and encouraging students with inquisitive minds to use their undergraduate studies as an opportunity to challenge themselves in STEM fields. This passion prompted me to apply to the Honors College at USM, where I was accepted and eventually elected as Vice-President of The Honors College Ambassadors. In this capacity, I have directly encouraged high-achieving students to pursue their goals by sharing my story. After becoming aware of my involvement on campus, the USM Dean of Admissions invited me to make a greater impact by speaking at a seminar to over 500 high-achieving prospective students about my experiences in research (**the only undergraduate from my university to receive this invitation)**. The following semester, I was approached by a freshman polymer science major who directly attributed her decision to attend USM to my speech at that event. Transformative experiences such as these motivate me to continue mentoring and creating opportunities that involve minorities in STEM fields. I hope to continue this mission through graduate student organizations that place an emphasis on outreach.

Future Goals

My experiences as an undergraduate researcher have demonstrated my potential to contribute to the vitality and diversity of scientific researchers in my field and beyond. These experiences have solidified my confidence that earning a Ph.D. in chemical engineering promises the most direct means of making a tangible impact in the lives of future generations. It is my goal to operate my own laboratory, teach and inspire the next generation of researchers and scientists, and provide opportunities for underrepresented students. By earning a graduate education in chemical engineering, I will continue building an interdisciplinary foundation that will strengthen my skillset as a research professor and allow me to lead efforts that contribute to potentially life-extending wearable electronics.

The path I have taken, while indirect, has shaped me into a resilient and ambitious researcher with a drive to contribute to improvements in soft devices, hopefully at Stanford University. Stanford's Doctoral Program in Chemical Engineering is compelling to me because it includes an interdisciplinary study of polymer physics, molecular thermodynamics, and applied mathematics. Additionally, I look forward to having the opportunity to contribute to advancing flexible electronic devices through the collaborative Stanford Wearable Electronics (eWear) Initiative. With the guidance of faculty with expertise in the design and fabrication of organic electronic devices, I will delve more deeply into problems facing the functionalization and scale-up of wearable electronics while equipping myself with the necessary skills to become a research professor and principal investigator in this field. With these goals in mind, the NSF Graduate Research Fellowship Program will advance my research aims by providing an opportunity to join the research group that best matches my professional objectives and by providing the monetary assurance needed to focus my free time on the mentorship of underrepresented students like me.