[Statement of Purpose]

All products that Samsung makes, TVs, mobile phones and others, utilize the circuits that I improve as a DFR (Design For Reliability) engineer at Samsung Electronics. I find they are even fulfilling for consumers not only in South Korea but even in remote places such as Alaska. I am enabling solutions ranging from performance to reliability of ICs by providing a more stable design environment. As Samsung fabrications operate 24 hours a day, I used to stay up all night to acquire proper data and solutions. This is because we should guarantee that our commercial devices maintain their operating specifications even under severe environments, such as the jungle or desert.

I am still hungry for my work, however, because there are still quality issues in our life which may lead to serious personal injuries. Above all, the paradigm is shifting to the era of “Smart Everything” (AI, IoT and autonomous flying cars) where semiconductors play the main role in each product.

This is why I desire to go into academia. Samsung is definitely a competitive company, and I learned a lot (fulfilling, collaborating, challenging) for close to seven years. Without clear ROI (Return On Investment), however, creative but not profitable ideas are hard to be realized. Moreover, at least from my point of view, the more we pursue PPA (main characteristics for device technology-Power, Performance, and Area), the importance of reliability and robustness is increasingly overlooked. I felt limited to spend my time and resources researching and resolving issues.

I would like to be involved especially at the earlier levels of design. As nano-scale technology becomes more complicated, the challenges for modeling, methods, and tools are increasing. Therefore, I want to do research on more accurate and faster design methodologies not only according to reliability but also to design performance. Leveraging my work experience in transistor-level aging-aware design, I wish to extend my expertise by seeking a solution to intrinsic and extrinsic failures and eventually enhance the robustness of products.

I learned semiconductors in general, and also experienced the latest technologies for Samsung’s actual products. My team published a paper “Aging-aware design verification methods under real product operating conditions” in the International Reliability Physics Symposium (IRPS). I contributed to the implementation of models and tools to allow aging-aware simulation. We had issues that non-operating states, such as power down mode, caused unintended device degradation and aging-induced mismatching of the circuit. I implemented a degradation modeling that can be easily missed but can cause significant failures: off-state HCI model, off-state TDDB model, and HCI body bias model. Through this experience, I developed a habit of looking at things from a different point of view and examining parts that were taken for granted.

Strong field experience is one of my strengths. I believe that making products with excessive reliability is not the best choice. To increase performance without taking risk of failure, I developed a methodology using short time TDDB reliability data by collaborating with the device reliability team. For instance, because efuse cells are highly biased to program data, they are not competitive with traditional analysis methods. Through new methods, I was able to increase their lifetime and meet customers’ needs by realizing an excessive margin. Such experience helped me improve skills to identify needs and make realistic plans no matter what kind of research I do.

Furthermore, my life at college and Samsung has broadened my perspective in the semiconductor field. I learned the importance of finding a balance between performance and reliability. I am also interested in VLSI design and device technologies collaborating with data analysis and machine learning. Eventually, I want to enable a solution where simulation-based analysis provides data to discuss both performance and reliability without having to wait for tests.

I have various research ideas, because a wide variety of factors ranging from transistors to circuits make circuit reliability an extremely complex topic. Beyond existing modeling methods, if the aging effect can be observed through in-situ testing, both intrinsic and extrinsic modeling can be considered. Not only SPICE-based aging simulation for analog blocks, I think aging-aware STA based on machine learning modeling can be a way to verify digital blocks. Moreover, as applications are getting complicated with various users, I wish to do research on ways to increase the verification speed for all scenarios.

I learned how to overcome challenges in life. I had my ankle ligaments broken, so I rehabilitated more than a year and finally I won an amateur squash competition. I thought I was an introvert and afraid of change, but by participating in study groups at the University of Connecticut, I found that I enjoy new environments and getting along with different people. I earned the strength to overcome adversities that I might face during my graduate school years and the distant future. I also received a lot from society, being fully sponsored by the Korea Student Aid Foundation (KSAF) and Sogang University for academic excellence. Now, I want to return what I received throughout my life.

Through my life, I realized that I want to become a professional in the semiconductor industry. I expect my Ph.D. projects can be used as a foundation for a fruitful research career. I want to be an academic, but I also prefer opportunities from various industrial projects collaborating with worldwide technological trends. I want to go back to the industry and contribute to overcoming challenges. I dream of benefiting society with the help of great professors and colleagues.