REZA ALIASGARI RENANI

10/19/2025 | Personal Statement | Experimental Physics | Auburn University | PhD Position

My research objective is to contribute to the advancement of experimental condensed matter physics through the development of radiation-resistant semiconductor devices, in particular by investigating electronic properties at interfaces in wide bandgap materials like SiC for power electronics applications. The PhD program in Physics at Auburn University offers an excellent opportunity for me to pursue this goal. I am now completing the final year of my Master's degree in Plasma Physics at Moscow Institute of Physics and Technology, where my research on semiconductor devices exposed to different kinds of radiation has strengthened my interest in studying wide bandgap semiconductors. I am especially motivated by the possibility of exploring trap passivation and radiation damage effects at dielectric-semiconductor interfaces.

I joined Dr. Koveshnikov's laboratory in the Russian Academy of Sciences over two years ago to study radiation effects on microelectronic structures, focusing on electrical characterization of semiconductors and SiO_2-based MOS devices. We studied the impact of electron and gamma irradiation and hydrogen plasma treatment on MOS devices, identified traps by location (oxide, semiconductor, interface) and carrier type (electrons, holes). This work has resulted in a first-author publication[1] and provides insight into device stability under bias stress, radiation immunity, and oxide trap density at the dielectric-semiconductor interface. I also developed optimized MATLAB applications to automate the experimental characterization techniques, which reduced run-times and created measurement pipelines.

After my undergraduate degree, I joined the System-on-Chip Development Laboratory and the Laboratory of Plasma Systems under the supervision of Dr. Vasiliev to develop FPGA-based systems and to study radiation and plasma effects on these structures. I implemented video-processing algorithms by manual Verilog coding and by generating HDL from Simulink models. I verified functionality of the algorithms using testbenches and Python automation scripts. In the Plasma Lab, we ran experiments where an FPGA with an attached camera and a synthesized image-processing design was placed in an electron-beam plasma system with low-pressure oxygen and exposed to electron irradiation and X-rays generated from a tungsten target. The FPGA output signal was monitored while thermal cycling was applied and preliminary functionality tests were performed.

My experience with irradiated semiconductors, plasma systems and device characterization motivated me to continue my PhD studies at Auburn University. I aim to investigate electronic properties at interfaces between dielectric thin films and wide bandgap semiconductors like SiC, focusing on trap passivation and radiation damage for power device applications. My background will enable me to contribute to the experimental projects by conducting electrical characterization and ion implantation studies in wide bandgap materials. I am enthusiastic to work under the guidance of Prof. Sarit Dhar at Auburn University to explore SiC/SiO2 interfaces and develop advanced power transistors.

[1] R. Aliasgari Renani, O.A. Soltanovich, M.A. Knyazev, S.V. Koveshnikov, Investigation of low energy electron irradiated SiO_2 based MOS devices by C-V and TSC techniques, Russian Microelectronics, 2023

Having been an international student and having collaborated across multiple scientific institutions, I am comfortable working between partner laboratories and I would welcome the opportunity to split time between Auburn University and other collaboration sites to advance this research. I am driven by research that couples numerical methods with experiments, and I look forward to leveraging my skills in device characterization for detailed analysis and to validate the data against results from experimental platforms like ion accelerator studies and MOSFET fabrication, which would ultimately contribute to breakthroughs in power electronics. It would be an honor to study and work at Auburn University in the United States, a country with longstanding traditions of scientific and cultural excellence.