1) Student name: Keith Marrero
2) Faculty mentor name: Dr. Patrick Fay
3) Project title: High-performance Solar Cell Fabrication

4) Briefly describe any new skills you acquired during your summer research:

During my research, I learned how to use inductively coupled plasma reactive-ion etching (ICP-RIE) and how to manipulate the machine to test various etching recipes. Additionally, I learned how to use a scanning electron microscope (SEM) to take clear images of objects on the scale of 10^{-6} meters.

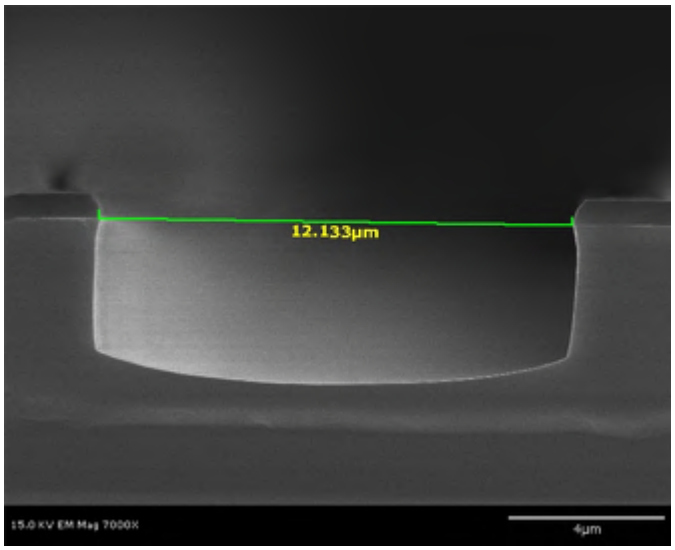
5) Please briefly share a practical application/end use of your research:

My research and research like it will hopefully lead to great advances in solar cell production and efficiency in an effort to make society more sustainable.

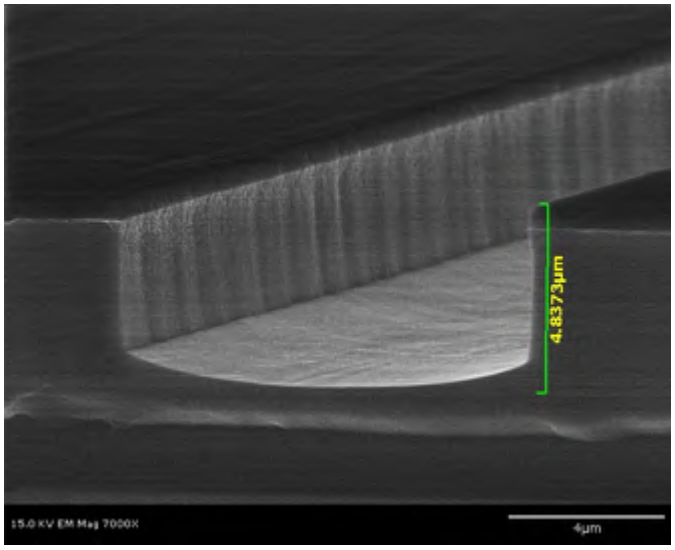
Begin two-paragraph project summary here:

My research involved etching multi-junction III-V solar cells, composed of various materials. These materials, from top to bottom, were arranged into four layers composed of InGaAs, InAlGaAs, GaAs, and InGaP, respectively. Using ICP-RIE trenches were etched into the backs of these solar cells. These trenches could later be filled with metal, which would be used to capture and conduct the energy generated by the solar cell.

The solar cell samples were attached to SiO_2-coated carrier wafers using thermal grease as an adhesive. I etched samples using the ICP-RIE because of its ability to etch in a Cl_2-based environment. I tested several recipes, using gases such as BCl_3, H_2, $SiCl_4$, and Ar. After etching, the samples were removed from the carrier wafer using Toluene as a solvent for the thermal grease. The samples were examined and imaged using the SEM (shown below). The samples were examined qualitatively to determine if the recipe used produced a trench with fairly smooth sidewalls and bottom surface.



SEM image of a trench etched using 15 sccm BCl_3, 2 sccm Cl_2, 2 sccm H_2, 100 W RIE, 300 W ICP, at 2.4 mTorr and 180°C for 8 minutes



Isometric view of same trench