Across the field of solar fuels research, there is little standardization of the systems and conditions in which we test and compare novel materials. As a Master's student in the group of Dr. Erwin Reisner at the University of Cambridge's Department of Chemistry, I have been tasked with developing a standard photoelectrochemical (PEC) reactor for use in testing materials and catalysts being developed by our group. My four-day visit to the laboratory of Professor Adélio Mendes at the University of Porto's Faculty of Engineering allowed to me place my work into the context of the broader technological challenges facing the development of solar fuels. The group, with Dr. Tânia Lopes leading the project on photoelectrochemistry, has spent the past several years investigating and honing state-of-the-art PEC devices for both laboratory and industrial applications (Figure 1); the group receives support from and collaborates with many of the other members of the European collaborative NanoPEC – which appears to be a Continental analog for the Solar Fuels Network, headed at EPFL in Switzerland.

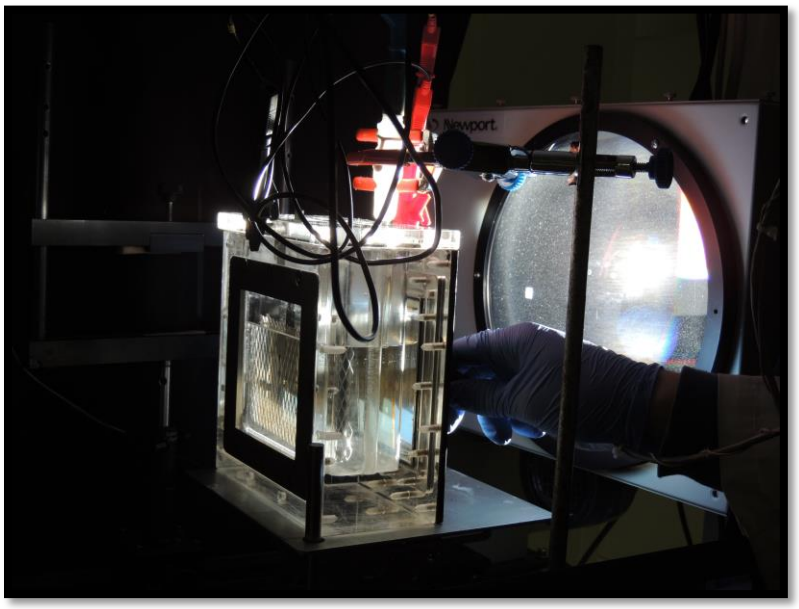

Figure 1: Large-scale PEC reactor designed by Dr. Tânia Lopes

Over the course of my visit to the Mendes lab, I was able to run experiments using these advanced PEC devices – studying larger-scale photoelectrodes (approx. 4 cm^2) that I had prepared, which most PEC devices do not have the capacity to support (Figure 2). I was able to interact intimately with these devices in order to determine the advantages of these instruments along with the drawbacks that they present in studying the sort of electrodes being developed here in the Reisner group. Additionally, I collaborated with the designers of these PEC devices throughout the

week – getting to know them personally, while also coming to understand the thought process used in designing the instruments. With regard to the PEC devices, the final component of the trip was meeting the manager of the workshop in Porto responsible for manufacturing the devices. Since my return to Cambridge, I have been corresponding with this gentleman in order to design and customize a standard PEC device for the Reisner group, based largely upon the earlier work of Dr. Lopes in Porto.

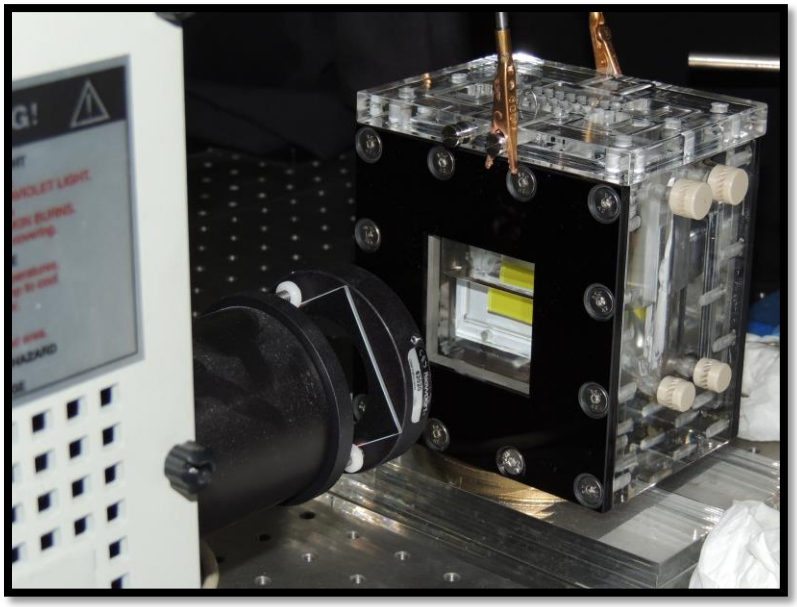

Figure 2: Using the Porto PEC reactor to study my large-area $BiVO_4$ photoelectrode

Outside of the context of the PEC devices, I was able to understand the engineering approach that the Mendes group is taking toward the industrial implementation of some burgeoning alternative solar energy technologies. In addition to scaling up the PEC reactors themselves, the group is working toward reproducible methods for manufacturing large-scale photoelectrode materials based upon hematite. The group also investigates the up scaling of materials for dye-sensitized solar cells (DSSCs), and has just made a monetarily significant sale of the patent for their laser-induced sealing technology for DSSCs. Aside from the science, of course a highlight of the trip was to take a weekend afternoon exploring the beautiful city of Porto, with its rivers, bridges, and breathtaking vistas (Figure 3).

Figure 3: View of the Porto city center from the opposite bank of the River Douro