**UT-Portugal Research Exchange Trip Report**

**Students: Karey Maynor and Mark Hamalian**

**Dates of visit to IST Portugal: Mar 10-28, 2025**

From March 10th through 28th, Karey Maynor and Mark Hamalian visited the University of Lisbon's school of engineering and technology, Insituto Superior Tecnico (IST) in Lisbon, Portugal. The purpose of this trip was to facilitate the exchange of research ideas, learnings, and techniques, as well as to make progress on the funded research topic – ionic liquids for $CO_2$ sequestration applications. Hamalian and Maynor are both 4th year PhD students in Dr. Vaibhav Bahadur's lab in the Walker Department of Mechanical Engineering at UT Austin. The Portuguese collaborators are Dr. Ana Ribeiro and Dr. Ana Moita at IST.

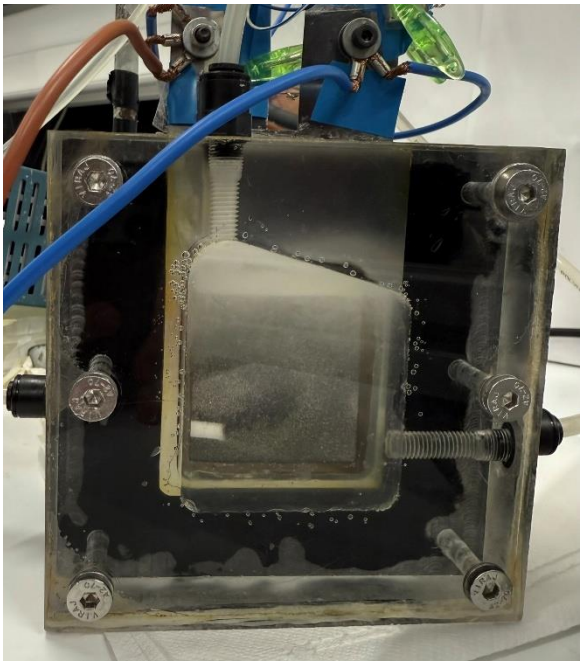
Part of our time when visiting the research labs at IST involved meeting the Portuguese researchers involved in the project, as well as their graduate students and other researchers at IST. We were primarily housed in Dr. Riberio's lab in the Chemistry department, but also interacted with Dr. Moita's lab in the Mechanical Engineering department (where the focus is on thermal fluid systems, which is Mark and Karey's field of study at UT). Overall, this was an excellent opportunity to hear about ongoing research in other areas, to see how different labs operate experiments-wise, and to learn new techniques or processes. Additionally, Mark and Karey had the opportunity to meet with Dr. Ana Ferraria to discuss measurement techniques for characterizing surface chemistry (i.e. XPS, FTIR, SEM, etc.), which is very relevant to multiple research efforts in our lab.

For this project, we were directly involved with experiments in Dr. Riberio's lab to synthesize polymer stabilized ionic liquids for use in $CO_2$ sequestration applications (see (a) in below figure). This process involved milling the polymer additive down to specific sizes, measuring the chemical composition using FTIR-ATR, measuring the size of particles (microscope), and then synthesizing the ionic liquids with the additive. This was an excellent opportunity to get hands-on-experience in a Chemistry lab setting, noting that our lab at UT is focused on heat transfer and fluids-related research in Mechanical Engineering. Experience and the time learning these techniques/skills was a direct result of this exchange trip. We believe that it is very valuable for graduate students interested in a career in research (either in academia or industry) to diversify beyond their main focus area.

Additionally, when visiting Dr. Moita's lab, we were able to observe a myriad of ongoing experiments related to thermal fluid systems. Projects involved characterizing hydrogen burner efficiency for industrial applications, development of microchannel heat sinks for solar voltaic panels, improving hydrogen electrolysis efficiency (see (b) in next figure), and studying the fluid flow dynamics in 3-D printed brain aneurysm models to improve medical diagnosis and

treatment. These projects used a wide range of instrumentation ranging from simple electrical and thermal measurements to more complex measurements such as particle image velocimetry (PIV) or infrared thermal imaging. Discussing such a wide range of projects and characterization techniques with the students involved was an excellent way to improve our own research understanding and capabilities.

(a) Preparation of polymer stabilizer (nano-additive) for use in ionic liquid synthesis in Dr. Riberio's lab.



(b) Experimental setup for hydrogen electrolysis in Dr. Moita's lab.

Additional notes from Karey Maynor:

On a professional personal note, visiting Lisbon and meeting everyone at IST was a wonderful experience. I really enjoyed being able to collaborate with researchers from a different university and to learn from them. Both researchers we worked with had labs with many ongoing projects in different areas of study (all brought together by either chemistry or thermal fluid systems), so it was valuable to see how these labs were managed. Ultimately, I want to work at a major research institution as a professor, so this research exchange was an incredible opportunity to learn and network. As a result of our time at IST working on this project, I thought of new research ideas for my own PhD proposal and dissertation. I have included this IST-related work in my PhD proposal that I presented in mid-April, and will continue working on this. Overall, this research exchange was a unique experience that will help shape my research career.

Now, on a purely personal note, visiting Lisbon and being able to spend an extended period of time in the city was amazing. In addition to completing our work, we were able to visit and explore much of the city and surrounding sites. One in particular was the Museum of Art,

Architecture and Technology (MAAT) in a neighboring town of Belem. Part of the museum is an old coal fired power plant that was converted into an exhibit where guests can tour the boiler room to learn how electricity is produced from coal. In this exhibit, there was a section on climate change and global warming with a very cool and interactive display where visitors can calculate their own personal carbon footprint. The display uses inputs like how much you drive or use public transportation, how much meat, fruit and vegetables you eat, what types of appliances you use, etc. (see (a) in next figure). Being involved in climate-related research, it was really nice to see such a cool museum exhibit teaching the general public about carbon emissions and their impact on the planet.

Knowing that I want a career in academia, unique opportunities such as this research exchange are invaluable when it comes to meeting collaborators and other researchers in similar fields. Once I graduate with my PhD from UT, I immediately plan to pursue a post-doctoral position. Prior to this experience, I had only minimally considered an international post-doc. After visiting IST and seeing the strong collaboration between EU and US institutions, I am now strongly considering an international post-doc. Thanks to this program, I now know people who I can reach out to learn more about their experiences doing post-docs out of their home country or researchers who might have relevant opportunities for me.

Additional notes from Mark Hamalian:

Overall my visit to IST and Lisbon was excellent, both professionally and personally. In the professional sense, it was such a unique and special opportunity to meet so many fellow researchers working on a wide range of projects. Such research exchanges provide a great opportunity to learn about projects both in my area of specialization and beyond. As such, I was both able to deepen my understanding on the thermal fluid projects of which I was already familiar with, and also broaden my understanding in chemistry (specifically ionic liquids) and XPS measurements. Furthermore, because this is an ongoing collaborative project, it is always nice to have the opportunity to meet in person with our research counterparts and strengthen the collaboration.

Personally, visiting Lisbon for 3 weeks gave me the opportunity to slowly but thoroughly explore the city in the evenings and weekends. This was my first time in Europe and I was blown away by the beauty of Lisbon, from the old buildings to the hills and views of the river. The azulejos might have been my favorite part (see (b) in next figure). I learned a lot about the history and evolution of these tiles from their Moorish and Chinese porcelain influences to their use in rebuilding the city after 1755. I am sure I only scratched the surface of all that Lisbon has to offer and I look forward to visiting again one day whether that is professional, personal, or both!


(a) Interactive display where visitors at the Museum of Art, Architecture and Technology in Belem, PT can calculate their annual carbon footprint.

(b) Example of azulejos (taken while exploring Lisbon).