

## Report on Austria lab placement

My name is Kieran Mylrea, I am a 3<sup>rd</sup> year Cambridge student at Robinson College. In my second year I studied Materials Science and Chemistry. At the end of my 2<sup>nd</sup> year, I participated in an 8-week lab placement at the Erich Schmid Institute in Leoben, Austria. I was working under Dr Megan J Cordill, with further supervision provided by Patrice Krieml. I chose this location as I have a large interest in the flexible electronic technologies on which the project was focussed. I was also drawn in by the prospect of 2 months in Austria. I enjoy hiking and running, so spending a prolonged period in such a mountainous country was very exciting to me. I was somewhat nervous to enter such a new environment, especially as almost everyone there was either a PhD student or older. My nerves were quickly settled by how friendly and welcoming everyone proved to be, always making time to answer any questions I had and helping me with experimental techniques. I was asked my opinion on topics and how to improve experimental set-ups frequently. This was very confidence-boosting and I am very grateful to all the people I worked with for being so accommodating.



ESI is a multi-national research institution and, luckily for me, the language used for communication was English. This proved incredibly fortunate as it meant I found virtually no language barrier at work, something which helped me settle into the institute very quickly.

My project was spent investigating the way in which the electro-mechanical properties of thin metallic films on flexible polymer substrates vary as you apply increasing strain, and how sample geometry (in my case, sample width) affects these variations. This is useful as thin films have a huge range of applications in the modern world, from food packaging to flexible electronics. Understanding the limits of the current film technologies is essential to allow the field to progress, so that these limits can be addressed and eliminated when future films are developed.

The systems which I focused on were Molybdenum (Mo) on polyimide (PI) or a bilayer of Mo and Aluminium (Al) on PI. They are simplified versions of films which find applications in flexible electronics, such as being front or back plane electrodes or as conducting wires between semi-conducting in microelectronic circuits components. For flexible electronic devices to be marketable, or just useable, they must be able to maintain properties at high strain values and for lots of bending cycles. This is necessary in order to create devices which have are functional over a long period of time, to ensure consumer satisfaction. This requires all components within the device to be able to withstand large amounts of cyclic strain application. Current prototype technologies fail in two main places: the radii which they can be bent to are too large (often around 3cm as opposed to the mm scale desired radius), plus they fail after too few bending cycles (are not reliable). It is often the

metallic thin films mentioned above which fail first, due to their brittle nature. Hence, development of these materials is required, as well as further understanding the fracture mechanics of said films.

I also completed several shorter projects. I imaged buckles for varying angles of sputter deposited Mo samples. The images taken were used to determine interface energies between PI and Mo. I also produced a guide to how to use the cyclic bending machine which I used for my bending experiments, including sections on how to carry out ex-situ techniques to determine properties such as crack densities and resistances at certain numbers of cycles. I helped with sample preparation for synchrotron experiments which the research group I worked for will carry out in the coming months, using techniques such as etching.

I thoroughly enjoyed my project, finding it very engaging. Some parts of it, including writing a final report in the correct style and ensuring that my experimental ability was good enough every day, proved challenging. I have certainly learnt a lot from the experience of working in a research group and am even more motivated to pursue this after completing my degree, despite the hard work which come with such a career.

During my time in Austria, I worked on my language skills, using apps like Duolingo and attempting to talk to people in Austrian German as much as I could. Whilst my skills did not develop drastically, I certainly improved and by the end was comfortable making small talk in German. This is something I will look to build on in the coming months and year.

I spent a lot of my free time during the week exploring the area surrounding Leoben. The Mur river runs through the city, providing a location for many an evening stroll along its banks. I did a lot of running, making use of the surrounding hills as a new challenge. Leoben has many good running routes to ensure that any ventures into the mountains remained safe. The area is stunning, as is most of Austria. I also formed a good relationship with my flatmate. He allowed me to experience several traditional Austrian customs, including letting me try on his Lederhosen, taking me to a beer and wine festival full of Lederhosen-clad singing Austrians, and showed me several good places to eat traditional Austrian food. As a vegetarian, schnitzel was not an ideal meal, so he showed me food such as Kasespitzer and Erdapfelsalat.

In order to get the most out of my time in Austria, I travelled to several places at the weekends. This ensured that the weekends did not get boring, and I got to see incredible natural beauty, at places such as Hallstatt and Klagenfurt. Hallstatt was really something else: it felt as if it shouldn't exist. The village consists of a small number of beautifully coloured traditional houses, a square and a church, but the main attraction is the incredible lake on the shores of which the village sits. I also experienced varying versions of Austrian city life, through visits to Vienna, Graz and Salzburg. I thoroughly enjoyed all the trips I took, with Hallstatt and Salzburg probably being the two which will stick in my mind for the longest, just due to the appearance of the two places being so distinct to anything we have in England.

I would say the placement has greatly reignited my love for science, vastly exceeding my expectations. After two hard years in Cambridge, I feel fortunate to have been able to visit and work at an institution carrying out fascinating cutting-edge research, with so many passionate people working together and helping each other as much as possible. It allowed 'the end goal' of working in research to seem attainable, something which at times over the past two years it has not.

I would like to take this opportunity to thank the Armourers and Brasiers' for the generous support I received, allowing me to partake in such a developing experience.