European Placement Report for the Armourers & Brasiers

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I am Sam, a third-year materials scientist and, thanks to the generous support of the Armourers and Brasiers, I spent a very enjoyable eleven weeks of my summer in Thun (Switzerland) at the Swiss federal research institution Empa. It was one of the nicest places I have ever had the pleasure of visiting, and the working environment was so enjoyable that I now intend to apply for a PhD there.

I worked in the low-dimensional materials group, focussing on creating oxide thin films by atomic layer deposition (ALD). This is a technique which uses a sequential pulsing of chemicals to deposit films one atomic layer at a time. It therefore provides very precise control of thickness, as well as producing films of higher quality (more uniform, conformal, and dense) than those deposited by the related chemical vapour deposition (CVD) process. Though ALD's industrial applications are currently primarily in the semiconductor industry, it has unique advantages which make it of interest to sectors ranging from photovoltaics to jewellery.

The rough objective of the project was to investigate the use of plasma as one of the precursors, since this known to increase the growth rate and quality of the films. In the end, I had far more experience of process engineering and relevant analytic techniques than of plasma ALD, giving me an invaluable insight into what it is really like to do research. As a result, I went from being convinced I would not do a PhD to being sure I want to do one.

My first couple of weeks were spent trying to achieve the necessary vacuum in the reaction chamber, which involved identifying leaks by deconstructing and cleaning it. Once it was vacuumproofed, the depositions could begin. The aim of the processes done while I was there was to optimise the 'recipe' of precursor doses, balancing film quality and growth rate against excessive precursor consumption. The characterisation of the films was done mostly using two techniques: ellipsometry and X-Ray Reflectometry (XRR), both of which were new to me, and I also developed some tools to visualise the data obtained.



Deconstructing the reaction chamber.



Using the ellipsometer at BFH.

There is an XRR setup at Empa Thun, but to use an ellipsometer I travelled with my supervisor to BFH in Biel. I appreciated the opportunity both to get hands-on experience with the apparatus, and to travel around the country. At BFH I also met some of the people whom I had seen on the weekly 'plasma coffee' video calls organised by my supervisor. These involved someone associated with the plasma/ALD group giving a halfhour presentation on a topic related to their research, followed by questions and discussion. I gave one in my penultimate week on the subject of calibrating ALD processes.

Though I enjoy learning languages and know a little German, I was apprehensive of the language barrier at work. I soon

discovered, however, that there was such a mix of nationalities that everyone spoke English anyway — though the international flavour and snippets of other tongues was also something I really liked. I was also struck by how friendly the working environment was, from the daily coffee break first thing



Weekend hike with colleagues.

After-work swim in the river Aare.

in the morning, to the hikes colleagues would go on during the weekends, to the 'apéro' leaving drinks held after work on a researcher's last day. I was quite touched that, even after only eleven weeks, I was considered to merit an apéro, and that so many people came.

I chose Thun for the placement because I had been on holiday to the region before and knew it was a great place for outdoor activities, but I was nonetheless surprised how completely I fell in love with the city and the region. As well as open-water swimming every day I was in the country, I also ran or cycled most evenings, and spent quite a few of my weekends hiking up the surrounding mountains. Five weekends I had visitors from home, and it was a real pleasure to share my love of the area with them. Outside of work, I also joined Seeclub Thun, a local rowing club, partly in order to practise my German. They were very accommodating of me, patiently speaking high German (rather than the very different Swiss-German), or English if I did not understand.

For all these opportunities I would like to thank again the Armourers and Brasiers for providing their support for the placement, which enabled me not only to spend a thoroughly enjoyable and productive summer in what is now my favourite place in the world, but has also rekindled my dream to live abroad, and has completely convinced me that I am not ready to stop studying materials science quite yet.



My apéro.