Mac Robertson Travel Scholarship Report

Kirstin Saunders

About me

My name is Kirstin Saunders, a second year PhD student in the microelectronics lab (meLAB) group at the University of Glasgow. This project is focused on the production of highly reflective optical coatings for the new generation of gravitational wave detectors (GWDs), with particular interest in nitride materials, and currently researching silicon-based nitrides. In 2024 I was awarded the Mac Robertson Travel Scholarship for a 2.5-month research secondment at the end of 2024 at the Fraunhofer Institute for Applied Optics and Precision Engineering (IOF) based in Jena, Germany which has a worldwide reputation in the field of optics and photonics including optical coatings and comprehensive characterization and metrology. The city of Jena is widely known for its optical glass and precision instrumentation advancements starting with Ernst Abbe, Otto Schott, and Carl Zeiss in the 18/1900s and now officially labelled “The city of light”.

My research interests are based on optical coating in particular the development of highly reflective interference coatings to be used in the 3rd generation of gravitational wave detectors (GWDs). These detectors have very strict optical requirements they must meet and therefore require specialised accurate measurement. At Glasgow we focus on the mechanical properties of the film such as mechanical loss and stress in order to reduce the coating Brownian thermal noise experienced by the coatings and improve the detectors overall sensitivity, however the optical losses such as absorption and optical scattering of the coating need the be accurately measured and considered.

Why did you apply for the Travel Scholarship?

I applied for the Mac Robertson Travel Scholarship to promote a collaboration between Fraunhofer Institutes of Applied Optics and Precision Engineering (IOF) - Coating and Characterisation Department and University of Glasgow – Microelectronics Laboratory (meLAB). During a conference, discussions regarding thin films characterisation techniques arose that focused on optical losses that arise in coating which are highly advantageous for this research. Shortly after a plan for a collaboration was made with the functional surface coating department at the Fraunhofer IOF. This collaborative work would allow us to expand our characterisation focusing on optical losses in films that are crucial for this project and will allow IOF to extend their research into a new field with their technology.

I was awarded £5000 from the Mac Robertson travel scholarship to cover the travel costs for collaborative research at IOF focused around the optical characterisation of thin films deposited at the University of Glasgow (UofG) under different deposition conditions. Without the funding this collaborative research would not have been possible. Therefore, I am deeply grateful for the support given by the Mac Robertson Travel Scholarship.

Details of your visit

IOF Coating and characterisation department specialise in photonics and optical characterisation of coatings and has developed advanced techniques such as highly sensitive Angle Resolved Scattering (ARS) and Laser Induced Deflection (LID) that determine optical losses of thin films both through light scattering and absorption respectively.

These techniques can allow the optical properties of the films to be determined, ARS utilises light scattering from the coatings which can be attributed to imperfections such as defects of the coating. This system can also be used to determine the surface roughness of the coating through the intensity change of ARS, from a relationship relating surface roughness and light scattering [1]. Absorption was measured through LID and determines the optical absorption of films producing a refractive index change/gradient with the heating and cooling of the sample when acted on by a laser [2].

Optical losses are a vital research point for this project as they can cause significant sensitivity issues inside GWDs. Optical losses such as scattering, and absorption can cause phase fluctuations and limit light squeezing [3] and cause surface deformation through heating and alter the refractive index through thermal lensing [4]. IOF has advanced scattering and absorption system in house to accurately measure coating optical losses at a variety of wavelengths with this projects interest in the infrared region at 1550nm. Furthermore, the expertise of IOF to correlate optical losses and imperfections provide valuable insights into the relevant loss mechanisms and hints for further improvements of the coatings.

Extra events

At the start of the secondment and Abbe Centre of Photonics and the Institute of Applied Physics were hosting a PhD networking-event. They held a poster session for this event and talks from Professors and Doctors from the local institutions and universities whose research is focused on Optics and Photonics and there characterisation as well. I was invited to present a poster of my current work at the University of Glasgow which helped me to get a better understanding of the local research environment and to get in contact with other PhD students and their research topics.

Also, during my stay Jena was one of the host cities to the Long Night of Science, where all the industries and research institutions open their door to the members of the public and show what projects and research they are currently working on. This event is open to all ages and includes, talks, demonstration and displays people can visit between the hours of 18:00 and 00:00 across the city.

Travelling Around

The weekends where ideal to take advantage of travelling around the Thuringia region making the most of the nice weather over the autumnal season. Jena is located in a valley on the Eastern side of Germany in Thuringia, it is surrounded by forests making it a very beautiful location for walking and hikes. There are frequent trains to Erfurt (the capital of the state of Thuringia), Weimar home to Goethe and Schiller (influential writers) and Leipzig making it easy to travel round the area.

Impact of the Travel Scholarship

This secondment has proved fruitful for collaborative research with a conference abstract submitted and a research paper underway. It focus on efforts surrounding thin film characterisation with an alternative deposition process and application for IOF and new characterisation techniques for UofG. The opportunity to personally being involved in the research group at IOF not only helped our local project and allowed me to get a broader view and grow as a researcher, it also initiated discussions for further collaborations.






References

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