# RS/SCI Student

Former SCI life member, Dr Sydney Andrew, left a legacy to SCI to support academic research into 'neglected science'. To fulfil this, SCI is delighted to have partnered with the Royal Society to fund PhD studentships, which complement the existing Royal Society Industry Fellowship Scheme.

**Lewis Fleming**
**University of the West of Scotland**

Lewis was awarded Carnegie Vacation Scholarship funding in 2013 to work on physical vapour deposition (PVD) of silicon and silicon dioxide mirror coatings with the aim of characterising low absorption multilayer films for potential use in future gravitational wave interferometry.

He graduated from University of the West of Scotland (UWS) in 2014 with 1st Class Honours degree in Physics and worked with DC magnetron sputtering of thin film optical coatings, including design and characterisation of single and multi-layer thin film samples during honours work. Said coatings comprised of different multilayer designs such as reflection and anti-reflection filters, edge filters, Fabry-Perot type filters and absorption filters using various metals and metal oxides. He completed his undergraduate (hons) degree under supervisor: Prof Frank Placido.

Lewis is currently working towards earning a PhD under Dr Stuart Reid and Professor Des Gibson with the Institute of Thin Films, Sensors & Imaging at UWS with funding from the Royal Society (RS) and Society of Chemical Industry (SCI) in partnership with Gas Sensing Solutions (GSS) Ltd. The project work involves using thin film optical filters to reduce nitrous oxide induced cross-talk in a state-of-the-art $CO_2$ NDIR gas sensor for potential use in capnography and surgical anaesthesia.

**Presentation abstract: 'Optimising $CO_2$ breath analysis using thin film optical interference coatings'**

Carbon dioxide ($CO_2$) gas sensing is an important aspect in the biomedical field of Capnography, where cheap, fast and accurate measurement of exhaled $CO_2$ vs. time is crucial in the evaluation of lung and tracheal function during surgical anaesthesia and is an under used bio-marker for respiratory condition. Current detection methods do not adequately meet these requirements and suffer from considerable cross-talk due to the commonly used anaesthetic gas nitrous oxide ($N_2O$). Depicted in (a) is a $CO_2$ gas sensor engineered by Gas Sensing Solutions Ltd and is an ideal candidate for breath monitoring for patients undergoing anaesthesia, with the only drawback being a slight sensitivity to $N_2O$.

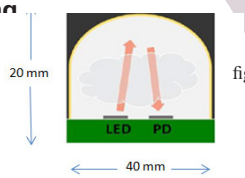

figure (a)

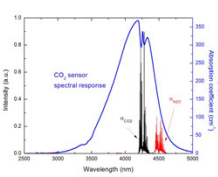

figure (b)

The sensor consists of a mid-IR LED-photodiode optopair mounted side by side onto a bridge-board facing into a gold coated plastic optic dome. Mid-IR LED emission reflects off the optic and is incident on the photodiode. $CO_2$ concentrations that have diffused into the chamber proportionally diminish the IR signal, thereby providing a measure of $CO_2$ concentration. The LED-PD optopair is sensitive over a 2500 nm – 5000 nm spectral region (b) rendering the sensor sensitive to $CO_2$ (4260 nm) and also to anaesthetic $N_2O$ (4500 nm). In this work, DC sputtered optical interference bandpass filters are applied to the diode structures and reduction of sensor spectral range has been demonstrated, minimising sensitivity to $N_2O$. This work paves the way towards potential commercialisation of state-of-the-art $CO_2$ gas sensors for breath analysis during surgical anaesthesia.