

UWA Microspectrometer research on its way to create major impact

UWA's Microelectronics Research Group has been working on Microelectromechanical Systems (MEMS) based infrared spectral sensors for over a decade and is now set to create major impact thanks to a licensing agreement recently signed with ASX listed Panorama Synergy.

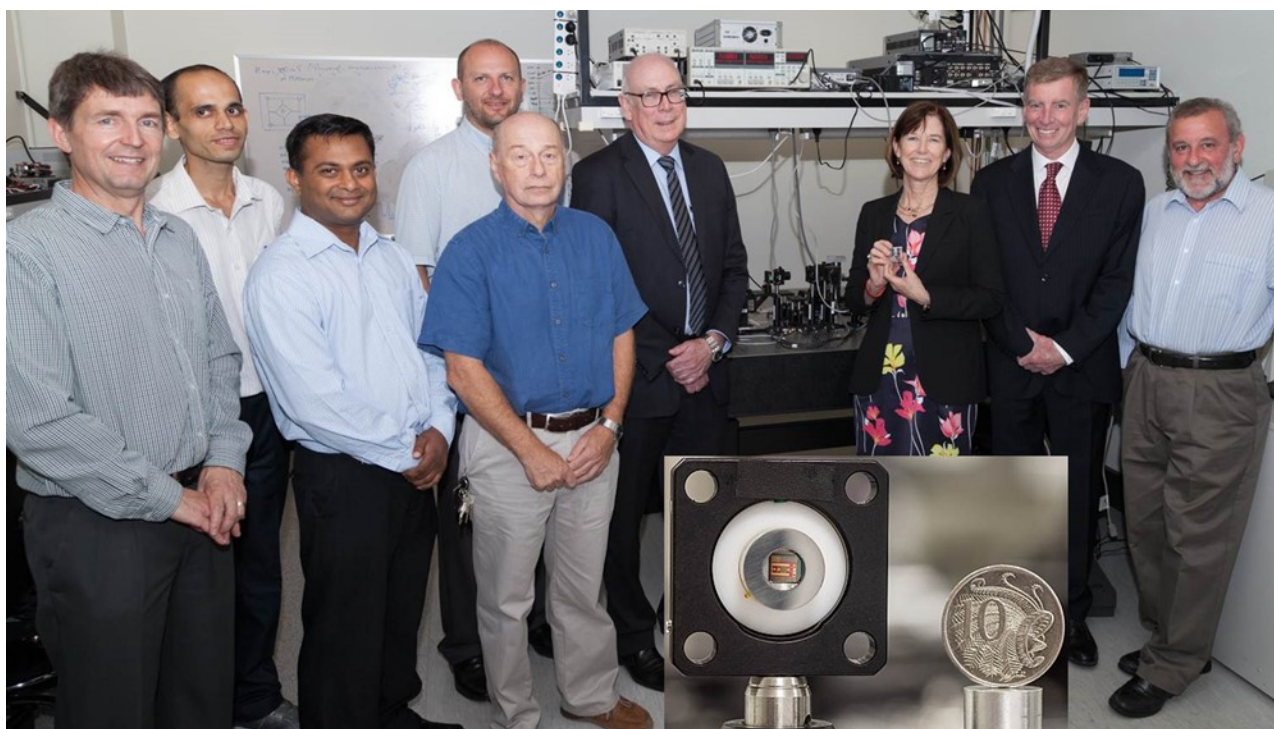
Infrared spectroscopy already has many uses – the grains industry uses spectroscopy to determine the quality (and hence value) of crops, the pharmaceutical industry uses it for raw materials testing and quality control and there are many other applications such as in the chemical industry, oil & gas, forensic science etc. Those applications however require expensive laboratory grade instruments, and that is set to change with the UWA Microspectrometer: it is a MEMS device, manufactured using cleanroom processes developed for the electronics industry, and hence can be mass produced at very low cost.

The potential of this technology has long been recognised by several US and Australian defence organisations as well as the Grains Research Corporation resulting in overall research funding of \$10m. Credit must also go to the Australian Research Council, and the Australian National Fabrication Facility (ANFF) for its support of the cleanroom infrastructure that made this research possible.

Professor Lorenzo Faraone vision for the sensor is no longer just science fiction: fitted to smartphones, the sensor will allow users to check the freshness of their fruit, veg and meat in real time just by pointing their phone at the product.

The team's vision has always been to create real impact, and welcomes the Turnbull government innovation statement that encourages translation of basic research to real applications and backs that up with relevant incentives.

The Microelectronics Research group is looking forward to many years of collaboration with Panorama Synergy to make sure the new sensor will be a success.



The Microspectrometer team (from right to left): Prof Lorenzo Faraone, Terry Walsh (MD of Panorama Synergy), Prof Robyn Owens (Deputy Vice Chancellor Research), Prof John Dell (Dean of Engineering), A/Prof Jarek Antoszewski, A/Prof Marius Martyniuk, Prof Dilusha Silva, Dr Dharendra Tripathi and Tom Schneppe (UWA Innovation office); Inset: Microspectrometer prototype.

In Focus - Sputter

Continuing our new series of articles focusing on capability of tools available at the ACT Node. This quarter we look at one of the noteworthy thin film deposition system of our labs - the AJA Sputter Coater. This state-of-the-art tool allows us to deposit a wide range of metals, dielectrics and compounds. It consists of three DC and three RF (13.56 MHz) power sources. The DC sources are suited only for the depositions involving conducting targets while the RF sources can be used for practically any films. Having said that, the choice of the power supply is highly material dependent e.g. ITO can be deposited by both, however, the resulting films are different in terms of the electrical properties.

In Focus - Sputter (continued)

The one deposited using DC has an order of magnitude better conductivity when compared to its counterpart sputtered using RF source. Contradictorily, zinc oxy-nitride films have better carrier concentration and copper oxy-nitride films show greater absorption in the solar spectrum when deposited with RF reactive sputtering. Our tool incorporates a load-lock that can fit up to one 6" wafer for faster process cycle. The samples can be heated up to 800°C and can be cleaned in-situ prior to deposition using the inbuilt argon plasma cleaning system. The targets are inclined at 45°C to the sample. The sample is rotated during the deposition to ensure uniform film deposition.

For depositing oxides and nitrides, we have a choice of either using the oxide or nitride target or using a metal target with reactive gases such as oxygen or nitrogen. Examples include SiO₂, HfO₂, SiN, TiN etc. A key advantage of reactive sputtering is that we can control the composition of the deposited film by varying the flow of the reactive gas. We can also perform co-sputtering of two or more materials e.g. to deposit AZO, we use Aluminium and Zinc Oxide target simultaneously. The concentration of Al is then controlled by changing the input power. It is also possible to do the so-called "reactive co-sputtering" by sputtering using two or more targets and reactive gases e.g. TiAlO_x, AZO, CuAlO_x, TiAlSiN etc.

Below is the breakdown of the films according to their applications that can be currently deposited. We are always ready to explore new materials, so please feel free to enquire about films you might be interested that is out-of-the-box. For updated list of targets, please visit http://anff-act.anu.edu.au/HTML/Tools_capabilities.html#Sputter.

Transparent Conducting Oxides: AZO, ITO

Optics: TiO₂, CaF₂, MgF₂, SiO₂, NbO_x, TaO_x, Al₂O₃, WSi₂, Au

Metamaterials: TiO₂/Au, Au/Al₂O₃, AZO/ZnO, TiN/AlN

Hardcoatings: TiN, AlN, CrN, TiAlSiN, CrO, BN

Magnetic Data Storage: TiN, Cr, CoCrPt, FePtO, MgO, CrTi

Resistive Switching: HfO₂, NiO, NbO_x, NbO_xN_y, TaO_xN_y

Semiconductor contacts: Au, Pt, Ag, Al, Ni, Ti, Cr, Ge, WTi, Pd, Zn

Photovoltaics: AZO, ITO, Si, SiO₂, SiN_x, TiO₂, Al₂O₃, Ag, Au, Zn, ZnS, ZnSe, C, NiO

Detectors/Sensors: MgO, ZnO, MgNiO, GeSiO, TiO_x, ITO

Biotechnology: Al₂O₃, ZnO, SiO₂

Superconductors: NbTiN, WSi, Nb, Ta, W

And lastly, who said that sputter is not good for lift-off? We have developed a process with optical lithography using negative resist maN-1420 that can give significant undercut to do successful lift-off as shown in Figures 1 and 2.

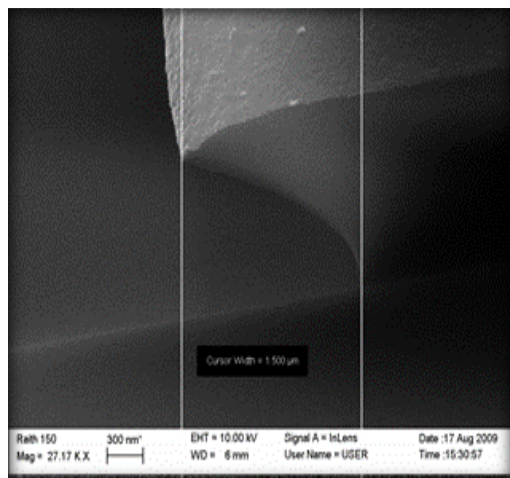


Figure 1: SEM image of maN-1420 showing undercut of 1.5 μm after developing

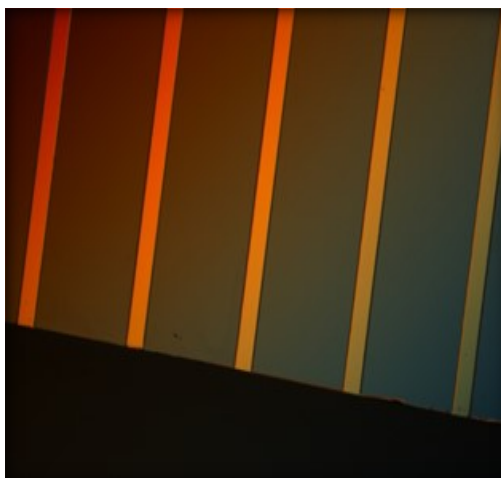


Figure 2: 100 nm thick sputtered gold lines after lift-off.

Welcome to our summer issue! This year ANFF ACT Node had to farewell our Node Administrator Mr Jeff Kealley who resigned from his position effective November 2nd, 2015. Jeff took a senior Administrator position at the School of Astronomy within ANU. Jeff was with us for more than 6.5 years taking care of all administrative, financial, reporting, newsletters, website etc. His departure has enormously affected the Node operation as you may have noticed that October billing has just been sent out to our external users but not yet for our internal ANU users ☺. We would like to take this opportunity to thank Jeff for all his contributions to the Node.

In November, we realised we cannot wait to fill the position till the recruitment process is finalised hence we made use of the ANU casual pool and found a suitable person to tackle the tasks of the Node Administrator and Ms Gemo Virobo started with us as Acting Node Admin per November 16, 2015. Gemo has started working on the delayed tasks like billing, website and newsletter and good progress has been booked so far. Please join me and warmly welcome Gemo.

Finally, we would like to thank all readers, especially the Node users for their work carried out at our Node. We wish you all a great festive season and we look forward to seeing you back at the Node next year.

Best wishes, Fouad K. and Gemo V.



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