University of Nottingham
Nanoscale and Microscale Research Centre

Nanofabrication suite

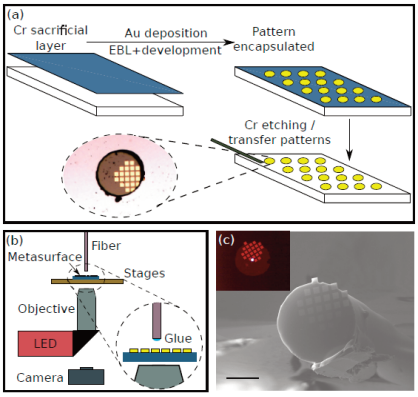
Nanofabrication is the process of creating nanometre sized features on a range of substrates. Electron beam lithography (EBL) can be used to create patterns as small as 40 nm. These patterns can then be transferred to a substrate via deposition of metals and/or dielectrics, or by selective etching of material. Our Nottingham Nanofabrication Suite can fabricate custom devices for a range of applications, and then validate them via a range of optical or thickness measurements such as ellipsometry.

Capabilities

- High resolution electron beam lithography (40 nm resolution)
- Photolithography (2 µm resolution)
- Thin film deposition of metals and dielectrics
- Wet or dry etching of substrates
- Thermal processing of materials
- Imaging ellipsometry
- Cell patterning

Typical applications

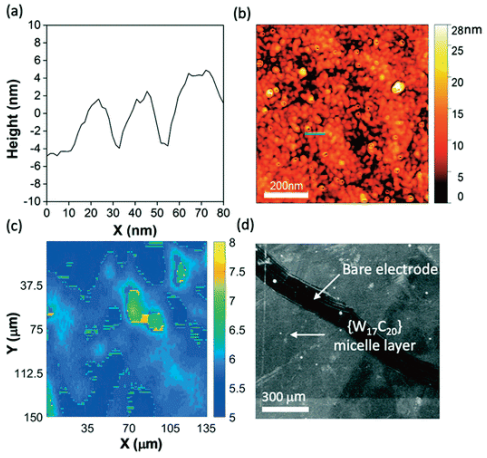
- Precise deposition of metals onto substrates such as glass
- Etching of substrates to create features such as gratings or waveguides
- Fabrication of bespoke designs for microfluidic chips
- Measurement of thickness and optical properties of 2D materials



Nanofabrication of ultrathin metallic metasurfaces for advanced imaging applications

Nanofabrication can produce precise nanostructures on a surface for a range of applications. Here, a three step procedure was performed to produce ultrathin metallic metasurfaces on an optical fibre surface. Electron beam lithography was used to pattern a chrome coated silicon substrate, photolithography to pattern a layer of resist material into discs (to encapsulate the metasurfaces), and wet etching to remove the encapsulated discs. These discs were then glued onto the tip of an optical fibre for use as endoscopic devices.

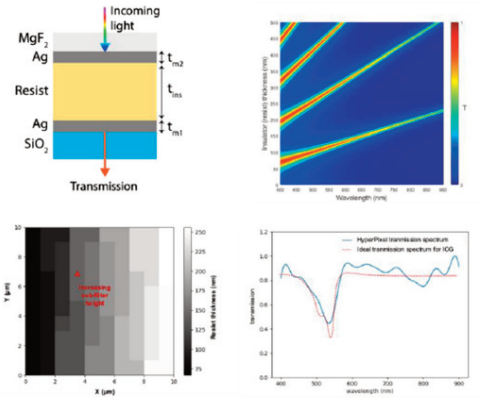
Rafael Fuentes-Dominguez, Fei He, Richard B. Cousins, Christopher J. Mellor, and George S. D. Gordon. Proceedings Volume 11953, *Optical Fibers and Sensors for Medical Diagnostics, Treatment and Environmental Applications XXII* (2022), 119530F.



Imaging ellipsometry for thickness measurements of self-assembled hybrid polyoxometalate nanostructures

Using imaging ellipsometry it was possible to determine the thickness and optical properties of monolayers formed on glassy carbon electrodes by self-assembly of hybrid polyoxometalate micelles. The combination of imaging ellipsometry with complementary techniques such as atomic force microscopy (AFM) and scanning electron microscopy (SEM) allowed the 6-8 nm monolayer thickness to be determined as well as full structural characterisation of the monolayers formed that have applications in electrocatalysis and sensing.

Sharad S. Amin, Jamie M. Cameron, Richard B. Cousins, James Wrigley, Letizia Liirò-Peluso, Victor Sans, Darren A. Walsh, and Graham N. Newton. *Inorganic Chemistry Frontiers* 9 (2022), 1777-1784.



Electron beam lithography for production of hyperpixel filter arrays

Electron beam lithography allows for the manufacture of unique materials that have tailored optical and electronic properties. Glass cover slips coated with a 22 nm silver layer were spin-coated with a greyscale polymer resist and then subjected to electron beam lithography to produce pixels of 0.5 – 10 µm size. The height of the pixels was also varied by controlling the electron dose. Once coated with a further silver layer this produced a filter array capable of customised spectral transmission properties.

Michaela Taylor-Williams, Richard B. Cousins, Calum Williams, Sarah E. Bohndiek, Christopher J. Mellor, and George S. D. Gordon. *Proceedings Volume 11954, Optical Biopsy XX: Toward Real-Time Spectroscopic Imaging and Diagnosis* (2022), 1195406.

Our facilities

Class 5 cleanrooms allowing for fabrication of a range of devices without the risk of contamination

Nanobeam nB5 instrument utilising an 80 kV electron beam with variable current allowing not only quick write speeds but also high resolution. Substrates from 5 to 76 mm can be used.

MJB3 and MA-6 Gen 3 mask aligners for repeated designs.

Corail 200II plasma etcher capable of reactive ion etching (RIE) and inductively coupled plasma (ICP).

Chlorinated and fluorinated gas chemistries allow for etching of Si, SiO2, GaAs, Al, photoresist and many more materials.

Range of deposition tools allowing for deposition of metals and dielectrics

Accurion EP4 imaging ellipsometer capable of measuring optical properties and thickness of thin films with a lateral resolution of <5 µm.

Woollam M2000 variable angle spectroscopic ellipsometer (VASE) capable of making optical measurements between wavelengths of 190-1700 nm.

Alvéole Primo system attached to a **Leica DCiM inverted microscope** for cell patterning.

Find out how nanofabrication could help with your applications, designs or solutions:
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