Institute for Photonics & Advanced Sensing (IPAS)

Optical Materials & Structures

Theme Leaders

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IPAS has facilities dedicated to the fabrication and characterisation of new forms of soft and silica glass and optical fibres.

Our Optical Materials & Structures research focuses on the development of new glasses with novel optical properties, advanced technologies for processing and shaping glass, the fabrication of micro and nanostructured soft glass optical fibres and the development of novel silica and polymer fibres, including the capacity for rare-earth and nanoparticulate doping. Key areas of strength include tellurite and fluoride glasses (both passive and active), and advanced preform technologies (both extrusion and MCVD based).

We have a strong focus on developing glasses and fibres capable of transmitting light in the mid-infrared that underpin new sensing platforms and lasers.

Our fabrication capabilities are complemented by our modelling research which focuses on predicting the optical properties of waveguides and fibres with micro and nanoscale structures. This includes new theoretical frameworks that enable us to explore waveguides and fibres with extreme properties and nanoscale features. IPAS has complete vertical integration of expertise and facilities from modelling to device fabrication.

Soft Glasses & Fibres

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Optical Structure Modelling

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Soft Glasses & Fibres

The activity on the fabrication and characterisation of novel soft glasses & fibres, ranges from fundamental science to application driven design and development. IPAS boasts highly specialised glass fabrication and processing facilities - controlled atmosphere, large capacity, high-temperature glass batching, melting & annealing, high temperature preform extrusion and fibre drawing with a 4m tower.

IPAS' characterisation facilities include state-of-the-art high-resolution environmental electron and atomic force/scanning near-field optical microscopes (AFM/SNOM) as well as transmission spectrometers and ellipsometers spanning from the ultraviolet to the far-infrared spectral region (200nm-30μm).

This capability underpins many of our research programs from glass development to novel nanocomposite materials. The University of Adelaide is currently the only institution in the Australia that can fabricate soft glasses and produce optical fibres from in-house materials.

Optical Structure Modelling

Our Optical Structure Modelling researchers develop light propagation theory within our optical fibres and planar waveguides. The group works closely with the Silica and Soft Glasses and Fibres groups, incorporating experimental evidence to feedback into our existing theories, driving the fabrication of new structures and underpinning the creation of new devices.

The group's work has led to IPAS fabricating the first soft glass photonic band gap fibre and more recently extending the theories of light propagation using high index waveguides, terahertz (THz) fibres or 'porous' fibres, and microstructured optical fibres and with nanoscale holes.

Silica Glasses & Fibres

IPAS Silica Glasses & Fibres research is dedicated to the production of research grade silica and silica fibres on our 6m fibre drawing tower. We design, develop and fabricate a wide range of specialty rare-earth doped and passive silica fibres, including single mode germano-silica and double/triple clad fibres.

We have state-of-the-art modified chemical vapour deposition (MCVD), ultrasonic milling, fibre drawing and characterisation equipment and several fibre laser test beds. We actively collaborate with academia and industry to produce custom fibres via research collaborations, contract R&D and consultancy.

ANFF Optofab Node Materials Facility

The glass and fibre fabrication facilities at IPAS bring together glass fibre and device development. Our capabilities have been recently been strengthened via investment from the LIEF and NCRIS/Super Science schemes. Through the ANFF Optofab Node we offer a range of services to external parties.

We are open to interaction with academia and industry and offer products and services in the form of contract R&D, consultancy and research collaborations. Examples of these products and services are:

- Supply of novel rare-earth doped soft glasses and microstructured optical fibres;
- Production of rare-earth doped silica preforms and fibres;
- Characterisation of glasses and fibres;
- Training and technical support where required;
- Direct access to instrumentation;
- Dedicated staff are on-hand to provide services, training and technical support to users where appropriate.

Case Study: Nanodiamond-doped Glass & Fibres

Funded by the IPAS Pilot Project scheme, we have recently collaborated with The University of Melbourne to demonstrate the incorporation of nanoparticulate diamond into tellurite glass. We have shown that this hybrid material can be made into optical fibres without destroying the unique characteristics of the diamond. The single photon emission properties of the nitrogen vacancy centre within the nanoparticulate diamond survive, and are actually enhanced, by incorporating the diamond into the glass. This work has already led to publications in international journals including 'Advanced Materials'.