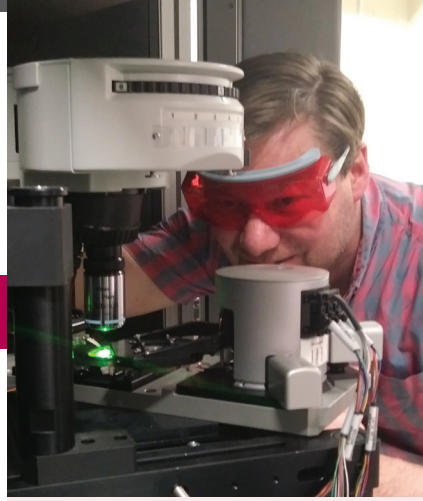
ANFF-SA

World-class characterisation techniques reveal data on opal structure



Providing micro and nano fabrication facilities for Australia's researchers, students and industry

On a quest to understand the structure of opal formation, South Australian researchers have exploited world-class characterisation equipment to establish the world's most extensive classification dataset of precious and semi-precious opals from around the globe.

Embarking on a combined spectroscopic investigation, Prof. Neville Curtis from the South Australian Museum, Dr Jason Gascooke from the South Australian node of the Australian National Fabrication Facility (ANFF-SA) and Flinders University together with A/Prof. Martin Johnston and Prof. Allan Pring of Flinders University, have uncovered novel data to advance opal classifications.

Bringing fresh eyes, knowledge and diversity in state-of-the-art characterisation techniques, Prof. Pring and his team of experts are on a mission to understand the micro-structure of opals and are working to unravel opal formation mechanisms and associated mineralogical and chemical aspects.

"Australia supplies 95 percent of the world's precious (gem quality) opals and is of significant commercial importance, yet very little is understood about opal," said Prof. Pring. "A reliable molecular model of the different types of opal doesn't yet exist and we are working to change this."

> *"ANFF-SA's Raman spectrometer is unique as it offers a non-destructive characterisation technique to measure molecular vibrations in the opal samples."*
>
> **Professor Allan Pring**

Using a variety of characterisation techniques and world-class equipment to record information on the 230 opal samples, Prof. Pring and his research team have recorded:

- molecular vibrations using ANFF-SA's non-destructive Horiba XploRA Raman spectrometer, Far Infrared spectroscopy at the Australian Synchrotron,
- the nature of water in opals using inelastic neutron scattering at Australian Nuclear Science and Technology Organisation (ANSTO)
- crystallinity using X-Ray Diffraction (XRD)
- local chemical environments of silicon and hydrogen atoms using Nuclear Magnetic Resonance (NMR) spectroscopy

"Conventional opal classifications use X-ray powder diffraction (XRD), a technique which requires the opal to be ground up for analysis," said Prof. Pring. "ANFF-SA's Raman spectrometer is unique as it offers a non-destructive characterisation technique to measure molecular vibrations in the opal samples."

Prof. Pring says the collaborative efforts of the Melbourne Museum, Adelaide University, Flinders University, ANFF-SA and Smithsonian National Museum of Natural History have enabled his team to generate a large body of opal samples and ground-breaking data which he is making accessible to all researchers with an interest in precious opal exploration or exploitation.

"The multispectral dataset provides a suite of characterised samples all measured under similar conditions, so trends or differences readily come to light and we even came across a few samples where it appears one type of opal is converting into another," said Prof. Pring.

"The dataset offers authentic references on gem quality and provenance authentication which is crucial with increasing reports of inferior opals being sold off as "Australian'."

Access Prof. Pring's publication "A Review of the Classification of Opal with Reference to Recent New Localities" online.

Co-located at the University of South Australia's Future Industries Institute at Mawson Lakes and Flinders University, ANFF-SA is an open access facility for researchers, academics and industry.

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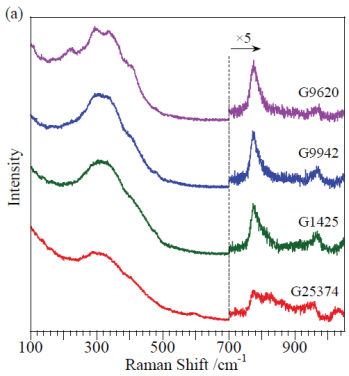
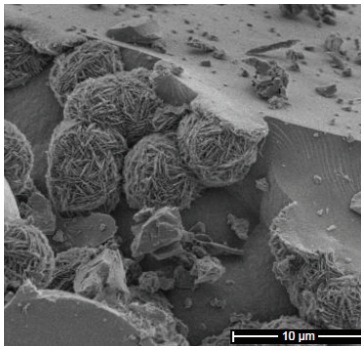


Raman spectra of opal-CT showing progressive structure. In ascending order: (a) simple opal-CT from Mezezo, Ethiopia (G25374) and increasingly complex forms from Eurolowie, Australia (G1425); Angaston Australia (G9942); and Iron Monarch, Australia (G9620).



SEM of sample (T22824)showing large spheres and bundles of plates.

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