ANBUG News – December 2017

President's Report – Ian Gentle

Welcome to the 2017 edition of the ANBUG Newsletter, an initiative of the group to keep our members up to date and share some of the excellent science being undertaken using neutrons in Australia and overseas. We hope you enjoy reading of some of the great things being done by Australian scientists as are highlighted in this edition. We recently organised the ANBUG User Meeting, which for many years has been a highlight of the ANBUG calendar and organised in cooperation with AINSE. This year for the first time, the User Meeting was run in conjunction with the User Advisory Group of the Australian Synchrotron and was branded as the ANSTO User Meeting. The change is partly a result of the fact that the synchrotron is now owned and operated by ANSTO, but is also in recognition of the complementary nature of synchrotron radiation and neutron beams. Our intention is to run a more traditional AINSE/ANBUG symposium every second year while every other year will see the joint meeting, hopefully bringing the communities together and leading to more people seeing the power of using both neutron and synchrotron radiation in their research. I was delighted to award ANBUG awards to Chris Ling and Rob Robinson at this year's meeting.

On behalf of the ANBUG Executive, I would like to encourage you to be involved in the group by attending these user meetings. As well as the more formal occasions, we welcome suggestions at any time as to how ANBUG can be an active voice for the users of neutron science in Australia. Please encourage your colleagues to join, and keep an eye on our website for news and information. Feel free to contact me at any time (i.gentle@uq.edu.au) if there's anything you would like to bring to ANBUG's attention.

Science Highlights

Life Without Water

Saffron Bryant, University of Sydney

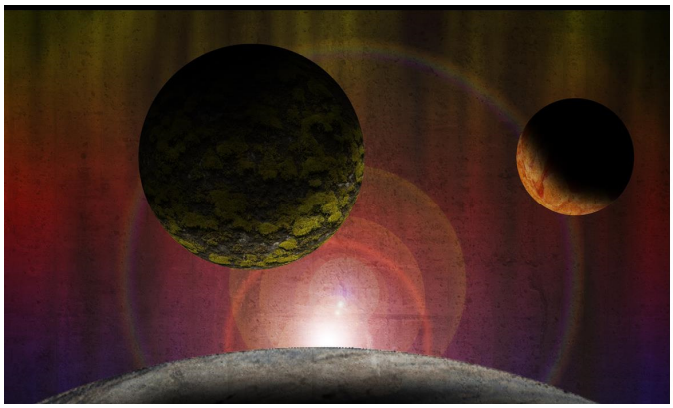
The recent discovery of the 7 TRAPPIST-1 planets,[1] has reignited interest in the possibility of alien life. But so often, the search for extraterrestrial life focuses on *terrestrial* limitations i.e. the need for liquid water. Recent research into non-aqueous ionic liquids and deep eutectic solvents suggests that water may not be as necessary to life as previously thought.

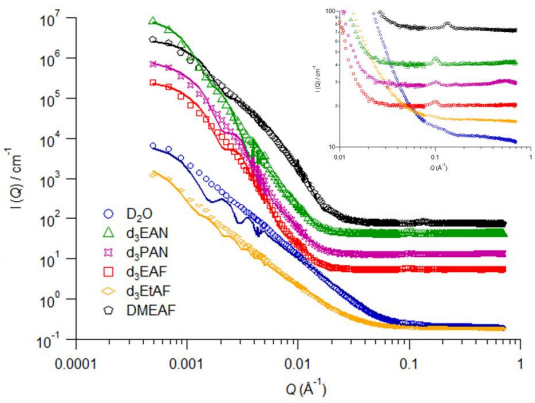
One of the basic requirements of life is compartmentalization, that is, separation and protection from the external environment. In living organisms this is usually achieved by the cell membrane, which can be excellently modelled by lipid vesicles.

Ionic liquids and deep eutectic solvents are non-aqueous polar solvents that are often liquid beyond the range of water. For example, ethanolammonium formate is liquid even at -80°C.

Research utilizing QUOKKA for neutron scattering has demonstrated spontaneous vesicle formation by phospholipids in a range of protic ionic liquids in the absence of water.[2] Further investigations also found spontaneous vesicle formation in a large number of deep eutectic solvents.[3] In both cases, the polarity and the nanostructure of the solvent strongly influenced vesicle formation.

These studies demonstrate that one of the basic requirements for life; a compartment, can spontaneously form even in the absence of water. Ongoing research also suggests that some proteins, specifically some membrane channels, can also function even in the absence of water. The findings of this work suggest that the search for extraterrestrial life should be expanded beyond terrestrial limitations, and the search for liquid water, into truly alien environments.





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2. Bryant, S. J.; Wood, K.; Atkin, R.; Warr, G. G., Effect of Protic Ionic Liquid Nanostructure on Phospholipid Vesicle Formation. *Soft Matter* **2017,** *13* (7), 1364-1370.
3. Bryant, S. J.; Atkin, R.; Warr, G. G., Spontaneous Vesicle Formation in a Deep Eutectic Solvent. *Soft Matter* **2016,** *12* (6), 1645-1648.

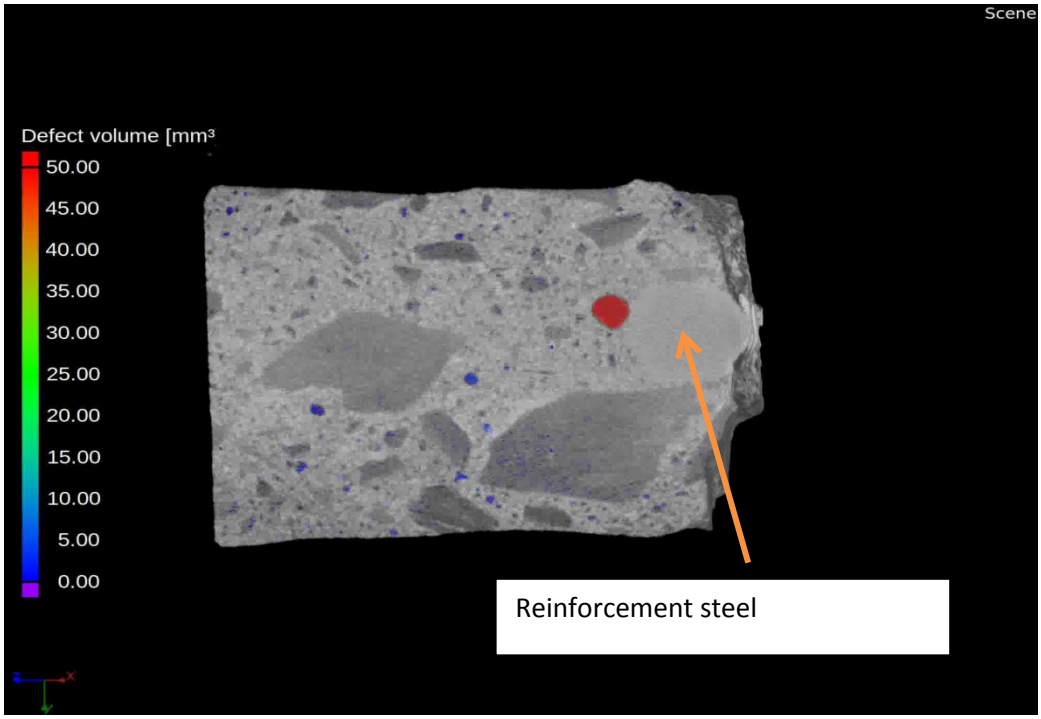
Neutron imaging on a concrete core

U. Garbe, L. Aldridge, P. Edmed

Neutron imaging at ANSTO (DINGO) [1] has allowed the investigation of concrete samples highlighting a unique ability to take advantage of high penetration depth and high contrast of light elements visualize the pores, flaws, cracks and even effects of bad mixing practice in steel reinforced

concrete. Concrete is a three phase system: aggregate, sand and cement paste, and in normal concrete the packing of the phases is optimized to infill voids and to save cost by minimizing the amounts of relatively more expensive cement component of the paste [2]. *NSW Transport Roads and Maritime Services* were able to supply a sample of a concrete core taken from a road which had a “slotted void” flaw in the concrete caused by placement of the reinforcement tie bar into the concrete. The 75 mm core was sliced using a diamond saw into a 50 mm cube. The sample was measured with a pixel size of 55 µm and 655 projections over 180 degrees. After reconstruction with the software package Octopus [3] a porosity analysis with VGStudio [4] was calculated. The coloured areas in figure 1 visualize the result with the color-coding assigned to the size of the voids (see legend figure 1). The sample shows large voids touching the reinforcement steel as shown in figure 1 which can be detected with neutron imaging. Especially with reinforcement steel present neutron radiation is beneficial because of its high penetration depth in metals as shown in figure the figure below.

In addition to imparting structural weakness, such flaws can lead to a loss of durability in the structure through the presence of large pores. Neutron tomography has been proven to be an excellent tool to analyze concrete cores.



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Report on AANNS 2016 – David Cortie

The ANBUG-AINSE Neutron Scattering Symposiums tend to be relatively special scientific events because neutron scattering is incredibly interdisciplinary, and spans many topical fields across science, history, medicine and engineering. The 2016 AANNS was no exception. Seventy ANBUG members gathered in the collegial atmosphere in the AINSE theatre to listen to topics ranging from the atomic structure of molecules to the exotic atmospheres on planets far across the solar system.

Since the last AANSS conference in 2014, the major development at ANSTO was the commissioning of three fully operational neutron spectrometers (PELICAN, EMU, SIKA) and the arrival of neutron imaging on DINGO. This was reflected in some fantastic talks from the emerging scientists in those areas. Floriana Salvemini spoke about neutron imaging of historical and cultural artefacts, and showed some beautiful examples revealing hidden facets of history and detecting forgeries. Joseph Bevitt gave a visually spectacular report on using DINGO to image fossils from the paleontological era which has revealed previously unknown facts about the diet of dinosaurs. Takatsugu Masuda from the Neutron Scattering Laboratory at the University of Tokyo kindly gave the audience some insight into the powerful capabilities of neutron spectroscopy for studying dynamics in magnetic materials.

A highlight of the conference was special plenary to celebrate Hugo Rietveld's contributions to powder diffraction analysis given by the former AINSE president, Prof. Brian O'Connor. It was fascinating to learn the little-known history of Rietveld's time at the HIFAR reactor and the University of Western Australia.

A survey was held at the end of the conference, with the responses being very positive overall. As per tradition, the annual ANBUG general meeting took place during a short break in the conference on the last day. An interesting development was a proposition to hold future meetings together with the X-ray user group at the Australian Synchrotron. This was warmly received by the ANBUG members present, and we look forward to joint meetings in a similar spirit in the next few years. This will allow an exciting scientific program with parallel sessions.

We thank our sponsors including AINSE, Ezzi Vision, Nu Scientific and Radiation Saunders. We look forward to future meetings!

ANBUG Awards 2017


In 2017, both the ANBUG Career Award and the ANBUG Award for Outstanding Research were awarded at the ANSTO User Meeting.

Dr Robert Robinson, ANBUG Career Award:

Dr Robert Robinson for his leadership in building and the transformation of Australia's Neutron Scattering facilities at the OPAL reactor over the past 15 years, into one of Australia's most significant research centres and a leading international neutron scattering research facility.

The establishment of the Bragg Institute at ANSTO as a centre of excellence for neutron scattering was, in many ways, made possible by the singular vision, commitment and collaborative spirit of Dr Robert Robinson. Dr Robinson acted as its Head from its inception in 2002, through its establishment until 2016.

The Bragg Institute initially oversaw the construction and commissioned eight instruments. The Super-Science-funded Neutron Beam Expansion Project, which increased the number of instruments to 13, was conceived, developed and financed under Dr Robinson's leadership; it was successfully completed in 2015.

The establishment of the Bragg Institute, the recruitment of staff, the construction and commissioning of a suite of state-of-the-art instruments and sample environments, formation and operation of a user office, development of research policy and strategy and maintaining partnerships could only be achieved by a highly competent, strong leader who could draw the best from everyone.

Professor Chris Ling, ANBUG Award for Outstanding Science:

Chris's major neutron scattering achievements have been in the area of crystallography, utilising a mixture of single crystal and powder diffraction methods. As appropriate he has supplemented these

studies with inelastic neutron measurements. He makes extensive use of the neutron scattering facilities at the new OPAL research reactor.

Chris is an extremely productive researcher having published thus far over 130 papers and has a H-index of 23. Highlights of the work he has conducted within Australia include the study of the unusual spin-gap behaviours in the hexagonal perovskites Ba_3BiMO_9 (M = Ru, Ir) and the study of potential cathode materials for sodium batteries.

In addition to his outstanding research Chris has played a significant role in promoting Neutron Scattering in Australia and in the wider Asian region. In particular he is a past president of ANBUG, he was the Chair of the very successful AOCNS meeting held in Sydney in 2015, and he is currently Secretary of AONSA – in this last role he has made a significant contribution to a number of AONSA Neutron Schools.