Nanoscale Organisation and Dynamics Group
University of Western Sydney

^{1}H and ^{13}C MR Spectroscopy and Imaging under Supercritical CO_2 Conditions: Application to Wood Dewatering

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A novel, integrated high pressure cell and dual ^{1}H/^{13}C resonator were constructed to enable high pressure imaging and spectroscopy to be conducted during the de-watering of wood using supercritical carbon dioxide ($scCO_2$) [1]. The high-pressure cell, certified to 200 bar, was machined from a single block of PEEK (poly ether ether ketone) and fitted with brass endcaps to accept the transfer lines. The inner bore (ϕ 23 mm) was sufficient to accept samples of green radiata pinewood (14×14×90 mm) having 2 or 3 annual growth rings visible. Carbon dioxide gas at natural abundance ^{13}C was used to generate supercritical CO_2 (T_{crit} 31 °C, P_{crit} 71 bar).

A series of ^{1}H images during successive pressure cycles is shown in Figure 1. These show the distribution and redistribution of water during supercritical CO_2 drying. Of particular note are the last three images, which show a redistribution of water from 1 bar to 145 bar $scCO_2$. This suggests possible interaction of $scCO_2$ with bound cell wall water.

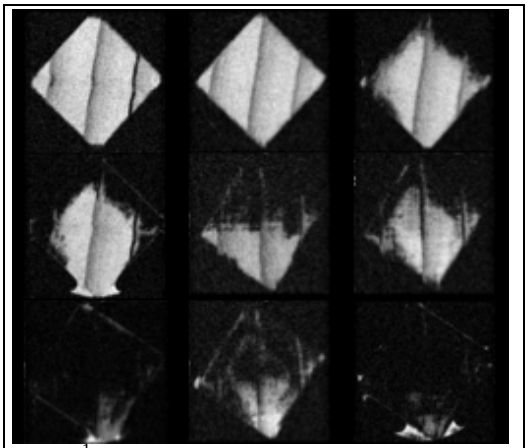

Fig. 1 ^{1}H image series (L-R, top-bottom): before expt, 1st cycle 120 bar, 4th cycle 120 bar, after 5th cycle 1 bar, 9th cycle 10 bar, 9th cycle 80 bar, end 9th cycle 1 bar, 10th cycle 145 bar, end 10th cycle 1 bar

Discussion of additional results including ^{13}C spectroscopy and chemical shift imaging will be included.

1. Behr V, Schmid M, Franich RA and Meder R (2013) An advanced, integrated large-volume, high-pressure autoclave and ^{1}H/^{13}C double-tuned resonator for chemistry and materials NMR spectroscopy and microscopy investigations. *Concepts in Magnetic Resonance. B. Magnetic Resonance Engineering*, 43B(2), 49-58.

Roger Meder has a particular interest in determining the variability in wood properties and rapidly characterizing the phenotype in order to improve processing and provide screening tools for genetic selection in breeding trials. He has a BSc and MSc in chemistry from Otago University in New Zealand and completed his PhD with Prof Sir Paul Callaghan at Massey University (NZ). He spent 16 years at the NZ Forest Research Institute where he first started using IR, NIR and NMR spectra to predict wood quality in order to provide rapid non-destructive measurement of end-use performance.

Upon moving to Australia in 2001, he ended up at CSIRO where he is currently Group Leader of the Forest Genetics, Genomics and Phenomics group within CSIRO Division of Plant Industry, which is located in Brisbane and Canberra. He is an editor of the *Journal of Near Infrared Spectroscopy* and is currently interested is the application of NIR spectroscopy to allow non-destructive, in-forest, rapid phenotyping of thousands of individuals within tree breeding trials and in his spare time is continuing long-term studies to investigate the wood water relationship.

Staff and students at all levels are welcome to attend.

Venue and Time:
This talk will be held on Friday May 10 from 3:00 – 4:00 pm at the Campbelltown Campus in Conference Room 5 in Building 22 (CA-22.2.04).

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