Time-Resolved Synchrotron Computed Tomography of High-Pressure Fluid Dynamics

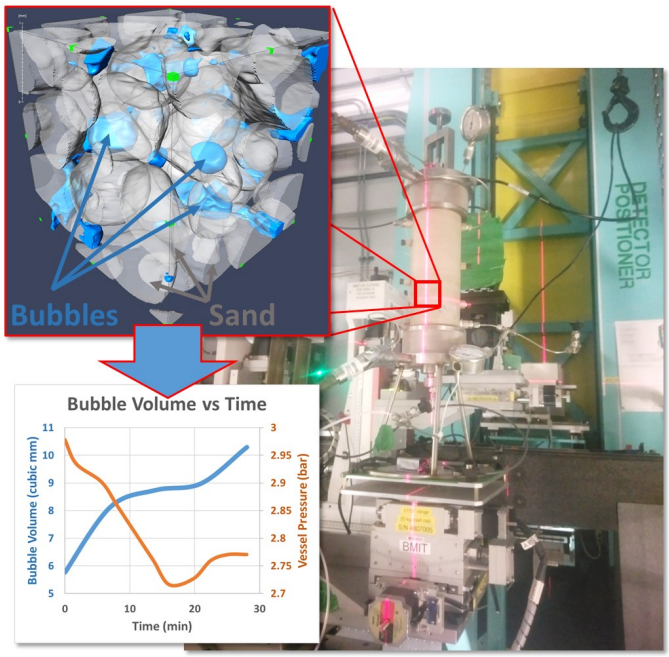
Toby Bond*[1] and Ian Gates[2]

[1] *Canadian Light Source, Canada*

[2] *University of Calgary, Canada*

* *toby.bond@lightsource.ca*

Synchrotron-based computed tomography (SR-CT) has proven to be an indispensable and uniquely suited tool for in-situ, time-resolved imaging of quickly changing dynamic systems [1]. Recent beamline development work at the Canadian Light Source (CLS) has focused on using SR-CT to observe dynamic fluid systems at high pressure. The ultimate goal of this work is to apply high-pressure, time-resolved SR-CT imaging to a simulated heavy oil system undergoing dynamic transitions at geologically relevant pressures. The result of this work is an in-situ pressure vessel that is x-ray transparent in a 360-degree plane about the fluid container while still being capable of operating pressures up to 7.5 MPa. The vessel has allowed for time-resolved study of high-pressure gas nucleation in a geological oil well sample, which has allowed us to observe complex fluid dynamics under geological conditions. The design challenges involved in developing a system that allows for application of high pressure while still maintaining sufficient spatial and temporal resolution to capture the necessary fluid behavior are discussed in detail. This work was carried out at the Biomedical Imaging and Therapy Insertion Device (BMIT-ID) beamline at the CLS in collaboration with researchers from the University of Calgary.



Time-resolved SR-CT scans (top left) of gas nucleation in heavy oil at high pressure are captured using a specialized in-situ pressure vessel (right). The resulting data (bottom left) is used to develop dynamic fluid models at realistic geological pressure

References

[1] Bond T, Zhou J, Electrode stack geometry changes during gas evolution in pouch-cell-type lithium ion batteries, Journal of the Electrochemical Society 164 (2017) A6158-A6162.