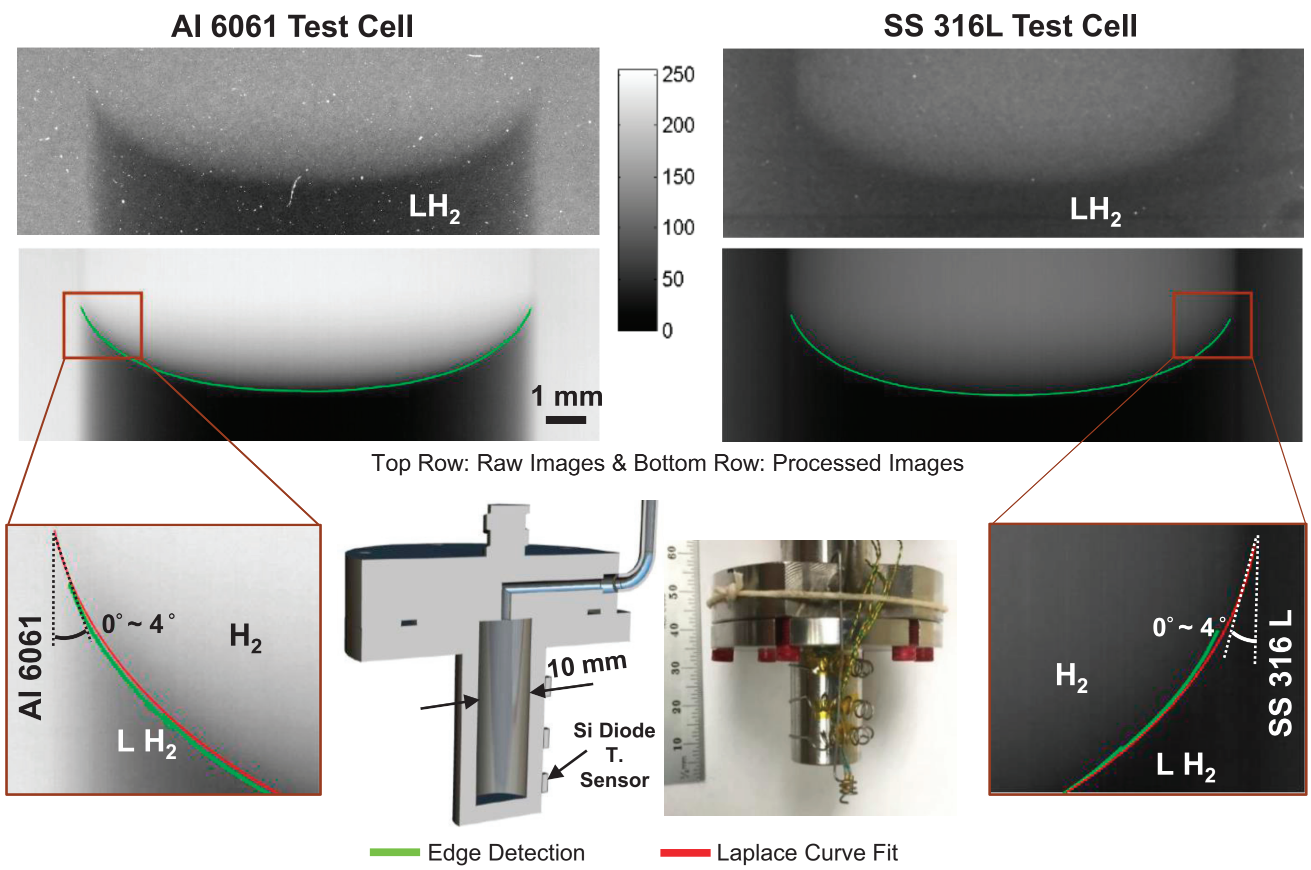
Neutron Radiography



Contact Angle Measurement of Liquid Hydrogen (LH_2) in Stainless Steel and Aluminum Cells

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One of the key limitations to long-term space missions is to avoid propellant boil-off in a microgravity space environment. Even with the use of active and passive controls of propellants, boil off is inevitable. Long-term CFD simulations on propellant behaviors depend on evaporation/condensation coefficients (known as accommodation coefficients) which are in turn dependent upon the wetting characteristics. Phase change experiments were conducted in the BT-2 neutron imaging facility at the National Institute of Standards and Technology (NIST) by introducing vapor H_2 in 10 mm Al6061 and SS316L test cells placed inside the 70mm 'orange' cryostat. Condensation is achieved by lowering the cryostat temperature below the saturation point and vice versa for evaporation. The high neutron cross-section of liquid H_2 in comparison to both the vapor and the test cell materials allows for visualization of a distinct liquid-vapor interface. Multiple images are stacked to increase the signal-to-noise ratio and the meniscus edge is obtained by detecting the pixels with largest gradients in intensities at the liquid meniscus. The contact angle is obtained by curve fitting of the Young-Laplace equation to the detected meniscus. The contact angle for Al6061 and SS316 is found to be between 0° and 4°. The uncertainty arises from edge detection, magnification, and resolution limits of the neutron imaging setup. The test was conducted at a saturation temperature of 21K (1.215 bar). The results from the neutron experiments will be then used in conjunction with FEA thermal models and kinetic phase change models to extract accommodation coefficients.

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