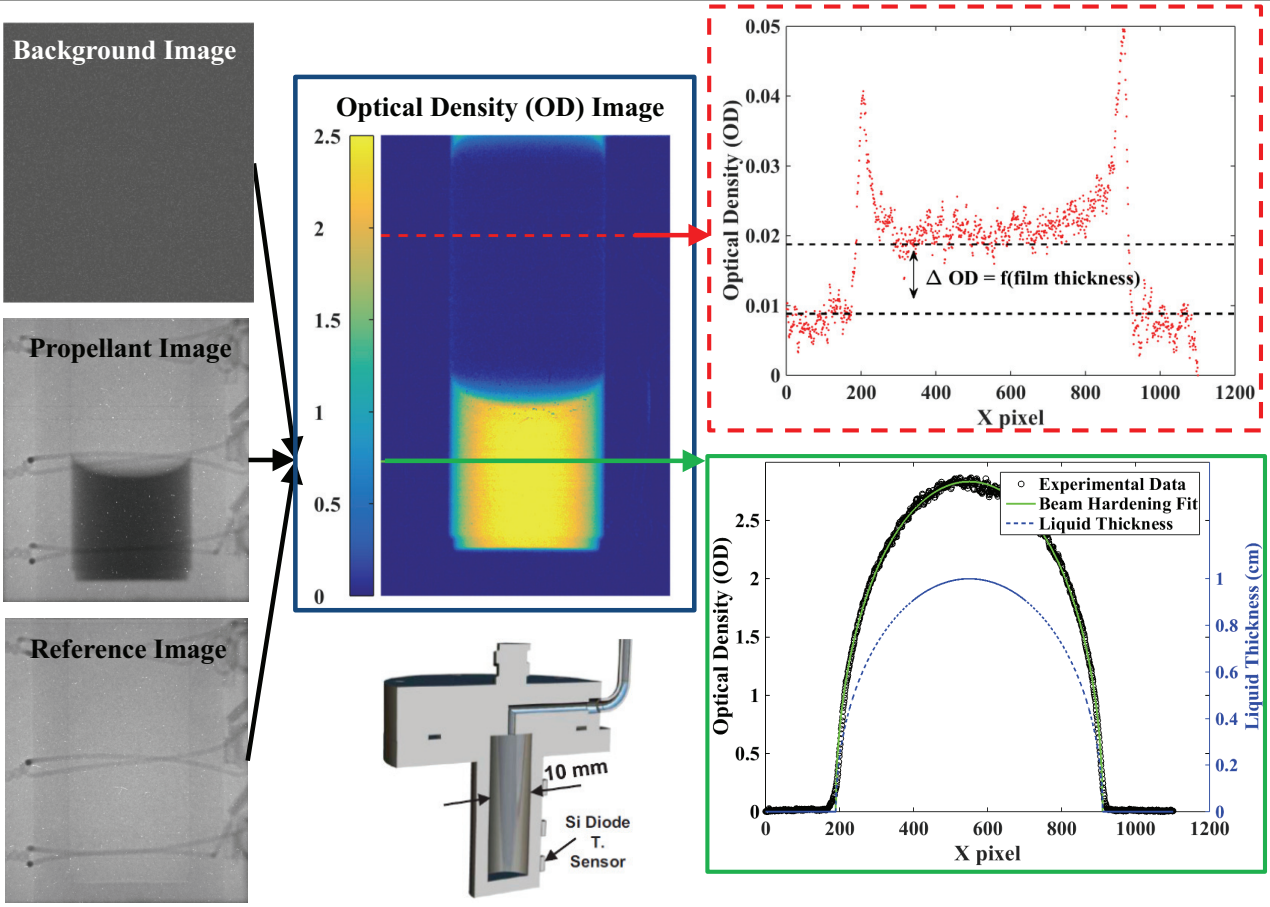

Neutron attenuation analysis of cryogenic propellants

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Neutron imaging enables direct visualization of evaporation and condensation of cryogenic propellants in metal containers such as aluminum and stainless steel. CFD models of propellant behaviors inside the large tanks have shown that a thin liquid film is formed along the interior surface, but this had not been verified experimentally. In the present study, neutron imaging is used to study evaporation and condensation rates of liquid methane inside a cylindrical 10 mm, Al 6061 cell. The liquid meniscus is clearly shown, but the spatial resolution is insufficient to directly image thin liquid films that may be on the interior surface. Optical density (neutron attenuation) analysis enables quantitative measurements of these liquid films. An optical density image is formed by removing the background noise and normalizing the liquid image with that of the empty cell. Optical densities are then transformed into a liquid transmission thickness using the Beer-Lambert law. This technique enables measurement of film thicknesses smaller than the spatial resolution of the imaging system. The above graphic shows an optical density image during condensation of methane and the corresponding horizontal scan which suggests that a 11 μm film exists on the wall. The images indicate that methane undergoes film-wise condensation and is perfectly wetting to aluminum.

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