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Mobile interfaces in tubes revealed for three-phase systems containing pressurized methane, p-xylene, and water using neutron imaging

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Interfacial tensions for systems containing model compounds for the freeze out from natural gas can be measured at high pressures by observing the interface shapes in tubes. Mobile interfaces in opaque tubes positioned parallel to gravity are easy to prepare and neutron imaging can provide related system properties (composition, density, etc.). We have observed the phase interfaces in the titanium tubes for the pressurized systems consisting of perdeuterated *p*-xylene (*p*-C8D10) layered over water (10.88 mol.% of H2O in D2O), and exposed to pressurized methane (CH4, 1.0 to 101 bar) at 7.0 to 30.0 ℃. The shape of the meniscus through the central plane of the axially symmetric interface follows the Young-Laplace equation

$$z = \frac{\gamma}{\Delta\rho \cdot g} \cdot \left(\frac{z''}{(1 + z'^2)^{3/2}} + \frac{z'}{r(1 + z'^2)^{1/2}} \right)$$

Figure 1: Young-Laplace equation

The tomographic reconstruction of the meniscus shape were based on the assumption of axial symmetry and derived from the single radiographies (pixel size 20.3 micrometer) using the onion-peeling algorithm [2]. While the shape of the reconstructed meniscus is crucial for the calculation of the interfacial and surface tensions, the swelling and composition of the phases provides information on the density change. Constraints determining the sensitivity and uncertainty of the method will be discussed.

References
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2 Vopička, O., Durďáková, T.-M., Číhal, P., Boillat, P. & Trtik, P. Scientific Reports 13, 136, doi:10.1038/s41598-022-27142-6 (2023).

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