ABSTRACT

Measurement of adsorption for pressures very close to the saturation vapor pressure

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A "two-interface" system of a single component fluid confined in a cylindrical container is a configuration in which a portion of a liquid phase would be above the vapor phase and a portion below. Based on Gibbs model of interphase, a thermodynamic analysis of a "two interface" configuration predicts that at equilibrium the contact angle at the upper three phase line is necessarily smaller than that at the lower three phase. The analysis also predicts that at equilibrium the pressure profile is the same as it would have been if the vapor phase were not there. A capillary system is considered that contains a single component fluid and is exposed to a gravitational field. A portion of the liquid is above and a portion below the vapor. A three-phase line is formed at both the interfaces. Three sets of experiments are conducted with water by varying the vapor phase length. The pressure profile across the two-interface and the contact angles formed at the three-phase line is determined for all the three experiments. Even for the simplest system the difference between the equilibrium contact angles at the upper and lower three-phase line is found to be tens of degrees. The experimental investigation supports both the theoretical predictions. The large contact angles at the lower three-phase line indicate an adsorption process occurring near the interface. Using the alpha-isotherm relations together with the Young and Gibbs adsorption equation the contact angles for the experiments are predicted. The predictions are found to be in close agreement with the measurements.