Morphological and bridging transitions at nanopatterned walls

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Using microscopic density functional theory (DFT) we study adsorption of a Lennard-Jones-like fluid at planar but chemically heterogeneous walls. The wall is formed of periodically alternating stripes of two different materials, one of which is completely wet ("solvophilic") and the other completely dry ("solvophobic") which are both of molecular widths. We consider two experimentally accessible scenarios: i) when the total amount of the adsorbed fluid is fixed, the fluid may adopt various configurations that are separated by a sequence of weakly first-order morhpological transitions; ii) when the system is open and can freely exchange particles with the bulk, the system undergoes bridging transition corresponding to a connection of small liquid droplets adsorbed on the wettable stripes over the hydrophobic gaps. We construct corresponding phase diagrams, analyze the shape of the liquid droplets and discuss the relevance of the macroscopic Cassie law.