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Wetting transitions on silicon nanowires with different surface functionalizations XIUMEI XU, GUY VEREECKE, ERIK VAN DEN HOOGEN, JENS SMEERS, SILVIA ARMINI, TINNE DELANDE, HERBERT STRUYF, IMEC — The wetting property of an ideal smooth surface is well described by Young's equation, on the other hand, the wetting behavior on a patterned substrate can be quite different due to the topographic influence. To date the transition from Wenzel or hemi-wicking state to the metastable Cassie-Baxter wetting state is still an active research topic. In literature the patterned substrates have a typical feature size in the micrometer scale, and it has been found that although a complete wetting is achievable on such dimensions, there can be a Cassie state of wetting in mesoscopic scale due to the air trapping by the nanometric roughness on the features. In this work we investigate the wetting properties of nano-patterned substrates. Silicon nanopillars (30-40 nm in diameter and 90 nm in pitch) are fabricated with different heights ranging from 70 to 450 nm, and different treatments are applied to functionalize the pillar surface to have a good coverage of water contact angles. Three wetting regimes are observed: hemi-wicking state for contact angles lower than 50 degrees, Cassie-Baxter state for contact angles larger than 80 degrees, and in between there is a sharp transition with the apparent contact angles increasing from 30 to 150 degrees. Wenzel model does not agree with the measurements for the entire range of the contact angle, indicating the wetting mechanism might be very different in the nanometer scale.

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