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Formation of nanoscale water bridges[1] ELISA RIEDO, Team 1, ROBERT SZOSZKIEWICZ, Team 1, TAI-DE LI, Team 1, JIANPING GAO, Team 2, UZI LANDMAN, Team 2, SCHOOL OF PHYSICS, GEORGIA INSTITUTE OF TECHNOLOGY TEAM — The water bridges provide stability to sand castles, act as transport channels for dip-pen nanolitography and increase adhesion and friction in micro- and nano- devices such as MEMS. The kinetics of capillary condensation and growth at the nanoscale is studied here using friction force microscopy and molecular dynamics calculations. At 40% relative humidity we find that the meniscus nucleation times increase from 0.7 ms up to 4.2 ms when the temperature decreases from 332 K to 299 K. The nucleation times grow exponentially with the inverse temperature 1/T obeying an Arrhenius law. We obtain a nucleation energy barrier of 7.8*10ˆ{-20}∼J and an attempt frequency ranging between 4-250∼GHz, in excellent agreement with theoretical predictions. These results provide direct experimental evidence that capillary condensation is a thermally activated phenomenon.

[1]R. Szoszkiewicz and E. Riedo, Nucleation time of nanoscale water bridges Phys. Rev. Lett. 85 135502 (2005).

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