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Probing the hydrophobic interaction using high-resolution frequency-modulation AFM ITAI SCHLESINGER, URI SIVAN, Technion - Israel Institute of Technology — The hydrophobic interaction has been studied extensively over the past few decades with only partial success. Several mechanisms have been proposed to explain this ubiquitous force but none was fully established. Experimentally, the force has been studied in great detail at distances larger than 2-3 nm where the static AFM and the surface force apparatus that served those measurements were stable. Little is known about the short-range interaction and even its sign. Using a high resolution FM-AFM, which was free of that instability, we succeeded in measuring the full distance dependence of the force and found that the hydrophobic attraction seen at long distances turns into pronounced repulsion at shorter distances (that may nevertheless reach $\sim$3 nm) coupled to an oscillatory force profile. Simultaneous measurements of the dissipative component of the interaction reveal an anomalously large dissipation commencing abruptly at the point where attraction begins. The dissipation is more than two orders of magnitude larger than expected from water viscosity or from similar measurements between hydrophilic surfaces. These findings were traced to the accumulation of air near the hydrophobic surfaces.

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