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A Simple Instrument for Measuring Surface Forces in Liquids
JAMES HANNON, RUDOLF TROMP, RICHARD HAIGHT, ARTHUR ELLIS, IBM Research Division — We have constructed a simple instrument to measure the interaction force between two surfaces in solution, or in vacuum. Specifically, we measure the interaction between a lens and a thin silicon cantilever. Either the lens, or the cantilever (or both) can be coated with the species of interest. When the lens is brought close to the cantilever surface, the force of interaction causes the cantilever to bend. By measuring the deflection as a function of the distance between the lens and cantilever, the long-range interactions between the two surfaces can be determined. Our approach includes three important innovations. First, a commercial lens with a radius of $\sim$ 1 cm is used for one surface. The relatively large radius of curvature enhances force sensitivity of the method. Second, we use optical interference (Newton's Rings) to determine the distance between lens and cantilever with $\sim$ 1 nm accuracy. Third, we make use of thin crystalline cantilevers (100 μm thick) whose elastic properties can be easily measured. We have achieved a force sensitivity F/R better than 0.001 mN/m. I will discuss the theory of operation of the new instrument and describe measurements made on SiO_2 and metal oxide surfaces in water.

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