

Theory of van der Waals microscopy

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The ability of scanning force microscopy to detect minute forces at high spatial resolution offers the possibility to systematically map the ever-present van der Waals (VDW) forces between probe and sample. Rigorously based on macroscopic quantum field theory the presented analysis involves an ab initio calculation of VDW forces in close relation to the experimental situation. It is shown that VDW forces directly reflect surface dielectric properties of the sample under investigation. Highly polar immersion liquids present between probe and sample are shown to significantly reduce VDW forces in magnitude. Additionally, some immersion media are found to cause a transition from attractive to repulsive interactions. The lateral resolution of VDW microscopy is estimated to be in the sub-100 nm range. First experimental aspects concerning VDW force detection are presented.