

The Hamaker constant, A , is a quantitative measure of the fundamental attractive van der Waals (vdW) interaction for microscale and nanoscale materials. This parameter captures each material's compositional effects on the vdW force, which is often needed as input for predicting the vdW interactions between particles and surfaces. Experimental attempts to determine A using an atomic force microscope (AFM) are typically hindered by issues inherent to the cantilever-tip-surface contact regime, such as surface roughness and deformation, and contact separation distance. Thus, we developed a new method for estimating Hamaker constants from the non-contact approach regime of an AFM experiment (Fronczak et al., 2017, *Langmuir* **33**, 714-725). This method invokes a quasi-dynamic description of the cantilever tip's approach to contact, in which the inertial effects of the tip motion are accounted for when analyzing the trajectory of the tip's approach towards the substrate. The method was tested experimentally using silica, alumina and polystyrene substrates, and was demonstrated to yield estimates of A for these materials that were in very good agreement with previously published Lifshitz calculations.

As with various other approaches to determining A , our new method relies heavily on the accuracy of the geometric model used to predict the interaction between the AFM tip and the substrate. For the initial validation experiments of our new method, we therefore focused on describing the shape of the cantilever tip as closely as possible, utilizing a complex model of a truncated pyramid with a spherical cap. Although this pyramidal geometry can be confirmed and the dimensions estimated via scanning electron microscopy (SEM), even high-resolution SEM images of the tip cannot provide sufficient detail to allow precise enough determination of the tip's geometric parameters.

Consequently, we also propose an adaptation of the method, in which these difficult to quantify geometric effects are still fully captured via the convenient description of the tip as an 'effective' perfect sphere. Hence, the geometric complexity of the cantilever tip is no longer explicitly required for the determination of A . First, a tip is 'calibrated', whereby the deflection at first contact between the cantilever tip and a smooth surface of known vdW properties is determined and an effective radius, R_{eff} , of the tip is calculated. The tip's approach to contact toward other similarly smooth surfaces can then be well-described by using only this single geometric parameter. We demonstrate the practicality and accuracy of this updated method by comparing the results with both the original pyramid model and Lifshitz approximations (when available) for flat substrates composed of silica, polystyrene, highly ordered pyrolytic graphite (HOPG), sapphire (α -Al₂O₃), Plexiglas (PMMA), and acrylonitrile butadiene styrene (ABS).

Then, the modified quasi-dynamic model was employed to study the strength of the adhesive interaction between TNT and several swab materials which are used as explosive detection devices at security checkpoints. This information is crucial for the development and improvement of next-generation swab detection protocols to further advance this field.

Finally, we also include the effects of thermal noise into our quasi-dynamic description of the cantilever motion to better understand how such noise might influence the accuracy of our method. We likewise determine, for the first time, the effects of instrument noise on the accuracy of other approach-to-contact methodologies for determining A .