

## **Frictional Force Microscopy and the Nano-Analysis of Fibres**

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Surface analysis at nanometre length-scales is currently very challenging. While recent advances in static SIMS have led to impressive improvements in resolution, routine imaging on sub-100 nm length scales is not possible. Near-field optical methods remain challenging. For the analysis of surface chemical structure on length scales of a few nm, there are currently no established characterisation tools. Friction force microscopy (FFM) is an attractive tool for addressing this problem. In FFM, lateral deflections of an atomic force microscope (AFM) cantilever are measured as the probe travels across the sample surface. These lateral deflections are strongly influenced by frictional interactions. While the qualitative value of FFM is widely appreciated, it also has substantial value as a quantitative tool too. Illustrations will be provided of the use of FFM for quantitative examination of surface composition and molecular organisation. It will be shown that FFM may be used to measure reaction kinetics with nm spatial resolution. A major obstacle to the exploitation of FFM has been a lack of understanding of the fundamental basis of the tip-sample interaction. In particular, it has not been clear whether the interaction is best modelled using Amonton's law (according to which the friction force is linearly related to the load) or a single asperity model (such as the JKR model). We have recently explored the influence of the medium on the tip-sample interaction and found strong correlations between the type of contact mechanics and the dielectric constant of the medium. Finally, illustrations of the application of FFM to the quantitative characterisation of fibre samples will be given. Fibres present significant challenges to the analyst, because of their sharp surface curvature and often heterogeneous composition. The measurement of coefficients of friction from hair and textile fibres will be demonstrated.