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Enhancing Sensitivity in Multifrequency Atomic Force Microscopy

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Abstract : Bimodal and trimodal AFM have provided additional capabilities to scanning probe microscopy characterization techniques. These capabilities have specifically enhanced material characterization of surfaces and provided subsurface imaging in addition to conventional topography images. Bimodal and trimodal AFM, being different techniques of multifrequency AFM, are based on exciting the cantilever's fundamental eigenmode with second and third eigenmodes simultaneously. Although higher eigenmodes provide a higher number of observables that can provide additional information about the sample, they cause experimental challenges. In this work, different experimental approaches for enhancing AFM images in multifrequency for different characterization goals are provided. The trade-offs between eigenmodes including the advantages and disadvantages of using each mode for different samples (ranging from stiff to soft matter) in both air and liquid environments are provided. Additionally, the advantage of performing conventional single tapping mode AFM with higher eigenmodes of the cantilever in order to reduce sample indentation is discussed. These analyses are performed on widely used polymers such as polystyrene, polymethyl methacrylate and air nanobubbles on different surfaces in both air and liquid.

Keywords : multifrequency, sensitivity, soft matter, polymer
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