中文摘要

本文分析交互阻尼效應和懸臂斜度對原子力顯微鏡 V 型懸臂探針撓曲及扭轉振動模態之影響。懸臂探針和樣品表面間交互作用之模型，可以兩個分別平行於法向及側向之彈簧和阻尼器組合來模擬。由 Rayleigh-Ritz 法可以得到撓曲及扭轉振動模態之近似方程式，這個方程式可用來預測懸臂探針之模態靈敏性，並獲得最佳的靈敏性。在 V 型懸臂探針的設計中，阻尼的作用是非常重要的，所以不可忽視。當接觸剛性小時，阻尼的作用會使懸臂探針撓曲及扭轉模態靈敏性降低。懸臂探針斜度對靈敏度亦有顯著的影響，當接觸剛性低時，靈敏性隨斜度之減少而增加，然而當接觸剛性變大時，情況則相反。此外，當接觸剛性很低時，增加探針長度會增加撓曲靈敏性。當接觸剛性高時，增加探針針尖的長度，也會增加撓曲靈敏性。

英文摘要

This article analyzed the interactive damping effect and cantilever slope on the sensitivity of flexural and torsional vibration modes of a V-shaped atomic force microscope (AFM) cantilever. The interaction of the cantilever with the sample surface is modeled by a combination of a spring parallel to a dashpot in the normal direction and a similar combination in the lateral direction. An approximate form for the sensitivities of both modes was derived based on the method of Rayleigh-Ritz. Using the approximate formulae, predictions of modal sensitivity may be made such that cantilevers with optimum sensitivity are created for specified uses. The results show that the effect of the interactive damping is significant and should not be disregarded in the design of V-shaped AFM cantilever. The interactive damping will decrease the sensitivities of both flexural and torsional vibration modes when the contact stiffness is low. In addition, the effect of the cantilever slope on the sensitivity is significant too. The sensitivity increases with decreasing slope when the contact stiffness is low. However, when the contact stiffness becomes large, the situation is reversed.Furthermore, increasing the leg length increase the flexural sensitivity when the contact stiffness is low. Increasing the tip length increases the flexural sensitivity when the contact stiffness is high.