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Studies of actual shapes of probes used for AFM tip-based nanomachining

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Abilities of Atomic Force Microscope (AFM) tips to remove materials during nanomachining depends critically on the tip bluntness. To describe the actual shapes of AFM tips, four different non-axisymmetric tips as received from the manufacturer were studied. Each tip was scanned first along a tip characterizer; and then it was used for depth-sensing nanoindentation of soft elastic polycarbonate (PC) samples. The tip characterizer is a special test structure consisting of an array of silicon sharp pin-like tips. The devices employed allowed us to extract very accurate data on the real shapes of the tips. Before the use of the tip characterizer, after its use, and after nanoindentation, two-dimensional Scanning Electron Microscope images of the tip profiles were obtained. The images showed that AFM tips were undamaged. The actual tip bluntness was characterized by approximation of the shape as power-law functions of degree d. The values of d extracted by the power-law fitting of the tips gave $d \approx 2$. However, AFM tips are not fixed vertically but they are actually inclined by 12^{o} to the cantilever beam. Applying the Borodich contact problem rescaling formulae to the load-displacement curves, one can also extract the degree d of the shape bluntness; the d values were in the range 3.4-4.5. These values were in agreement with the power-law fitting of the inclined tips. The inclination of the tip can affect sufficiently the effectiveness of nanomachining. Bluntness of the AFM tips used for studying the surface topography can be also characterized by the above procedure.

Biography

Zaynab N Alraziqi has completed her MSc degree in 2004 in Material Science from University of Technology-Baghdad. She worked as Assistant Lecturer at Applied Science Department-Universty of Technology since 2006. In 2013, she was awarded with a PhD scholarship from the Higher Committee for Education Development in Iraq (HCED). She has published 2 papers in national journals in Iraq. She gained a good experince in using Atomic Force Microscopy (AFM) through her PhD study.

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