Gold nanoparticle coated silicon tips for Kelvin probe force microscopy in air

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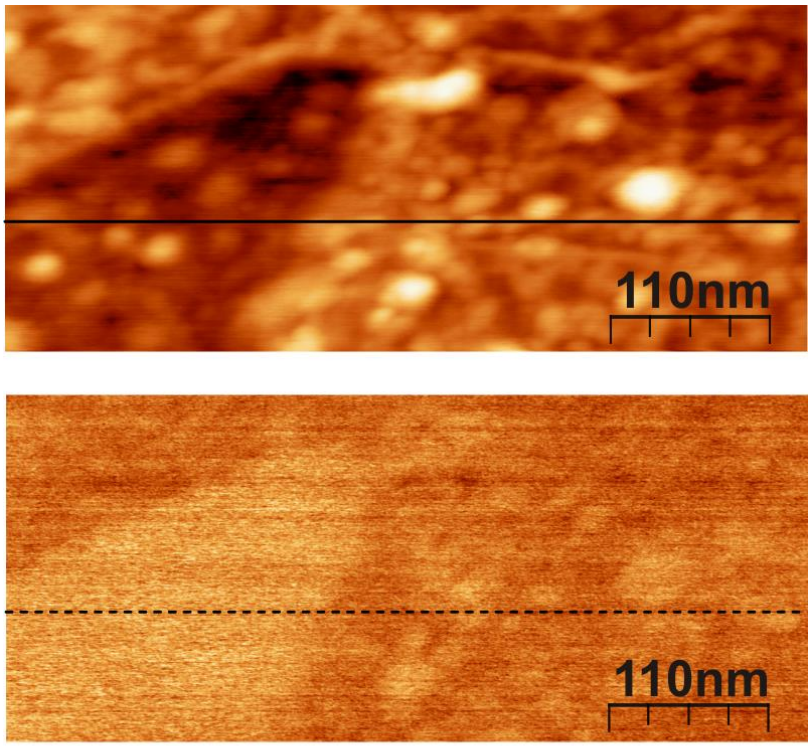
Abstract

The tip apex dimensions and geometry of the conductive probe remain the major limitation to the resolution of Kelvin probe force microscopy (KPFM). One of the possible strategies to improve the spatial resolution of surface potential images consists in the development of thinner and more durable conductive tips. In an effort to improve the lateral resolution of topography and surface potential maps, we have evaluated high aspect ratio conductive tips created by depositing gold nanoparticles on standard silicon tips.
Besides the already known general topographic resolution enhancement offered by these modified tips [1], an improvement of surface potential lateral resolution and signal-to-noise ratio is reported here for a variety of samples as compared to other regular conductive probes. We have also observed that the modified conductive tips have a significant auto-regeneration capability, which stems from a certain level of mobility of the nanoparticle coating. This property makes the modified tips highly resistant to degradation during scanning, thus increasing their durability. As demonstrated by the heterogeneous set of structures measured in the present study performed in air, the nanoparticle coated tips are suitable for KPFM analysis [2]. In particular, surface potential difference determination on graphene deposited on silicon, gold sputtered on a salt surface, large and mildly rough areas of ZnO films and small DNA molecules on insulating mica have been achieved with enhanced resolution.

References

[1] L. Martinez, M. Tello, M. Diaz, E. Roman, R. Garcia and Y. Huttel.Rev. Sci. Instrum. **82** (2011) 023710R.
[2] S. Hormeño, M. Penedo, C. V. Manzano and M. Luna. Nanotechnology **24** (2013) 395701.

Figures



KPFM measurements of graphene deposited on a silicon dioxide wafer. (Up) Topography and (down) surface potential image recorded using a Au NP coated tip. Line profiles of the topography and surface potential of the corresponding images.