Local detection of nitrogen-vacancy centers in a nanodiamond monolayer

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Nitrogen-vacancy defect centers (NV) contained in nanodiamonds (NDs) **[1]** are promising candidate in quantum information processing **[2]** and single photon sources **[3]** due to the capability of controlling their assembly on various surfaces. However, their detection with traditional optical techniques become challenging when probing high NV densities at the nanometer scale. Here, we combine scanning probe techniques to characterize in a monolayer the structural and electronic properties of NDs with sizes below 10 nm **[4-5]**. NDs are found to stabilize in the bucky-diamond structure where both C(111) facets and graphitic-like reconstructions coexist at its surface. We further observe by light-assisted Kelvin- and scanning tunneling- spectroscopy a clear signature of the sub-surface NV^1 centers at the nanoscale where conventional techniques are limited.

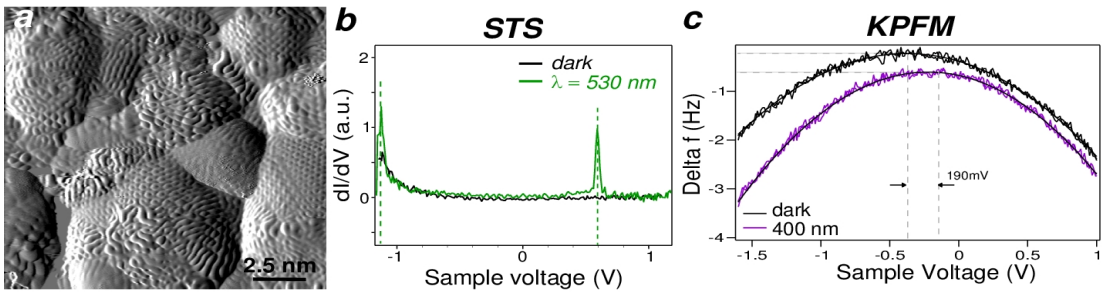

Figure 1: a) STM derivative image of the nanodiamond layer (bucky-diamond structure). b) Comparison of STS spectra obtained in dark and 530 nm illumination, showing the appearance of the NV centers electronic states. c) comparison of Kelvin spectra obtained in dark and 400 nm illumination revealing a LCPD variations induced by the photo-excitation of sub-surface NV centers.

References

[1] V. N. Mochalin *et al.*, *Nature Nanotechnol.*, **7**, 11, (2012).
[2] J. Warchtrup, *PNAS*, **107**, 9479, (2010.)
[3] I. Aharonovich *et al.Nature Photonics*, **5**, 397, (2011).
[4] L. Schmidlin *et al.*, *App. Phys. Lett.* **101** 253111(2012).
[5] R. Pawlak *et al.*, Nano Letters, in review.