Cryo-etching method for quantum constrictions in encapsulated graphene

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Abstract

We report on a novel implementation of the cryo-etching method, which enabled us to fabricate very low roughness hBN-encapsulated graphene nanoconstrictions with unprecedented control of the structure edges; the typical edge roughness is on the order of a few nanometers. We characterized the system by atomic force microscopy and used the measured parameters of the edge geometry in numerical simulations of the system conductance, which agree quantitatively with our low temperature transport measurements. The quality of our devices is confirmed by the observation of well-defined quantized $2e^2/h$ conductance steps at zero magnetic field. To the best of our knowledge, till now, this observation is the clearest quantization in physically etched graphene nanoconstrictions.
The proposed cryo-etching method is also scalable; we argue therefore that the success in the fabrication of such high quality simple systems and the scalability of the technique opens a novel promising possibility of producing more complex truly-ballistic devices based on graphene.

References

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Figures

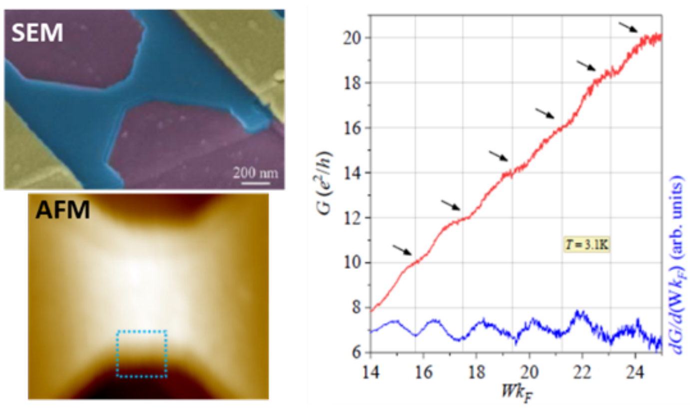

Figure 1. Top left: Coloured tilted SEM image of encapsulated grapheneNC.
Bottom left: AFM mage of encapsulated graphene NC. Right: Conductance G (red line) and transconductance (dG/dWk_F) versus Wk_F, where W is the width of the NC and k_F is the Fermi wavenumber. Black arrows highlight the position of the plateaus of conductance G separated by $2e^2/h$.