Correlative microscopy of graphene with SEM, Raman spectroscopy and AFM

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Abstract

Graphene has been speculated to be a suitable material for producing robust and sensitive Hall sensors [1] and biosensors [2] due to its ultra-high carrier mobility. A key challenge however is producing electronic grade, high mobility graphene at scale. Paragraf has realised this by being the first company in the world to produce graphene using our proprietary and commercially scalable growth method, directly onto target substrates without the need of a transfer process, using standard semiconductor manufacturing tools. [3] We cover all aspects of production, from the growth of graphene to processing into final devices, including Hall sensors and graphene-FETs. We also develop in-depth fundamental structural understanding of our graphene to be able to relate to device performance and electrical properties.

When investigating graphene structural features in detail, we employ a number of microscopy techniques to gain a deeper understanding of the features observed. However, as most microscopy techniques are on the micron scale, it is challenging to locate the same feature reliably using multiple techniques. To address this, we employed a relatively simple and low-cost method from [4] of glueing down a TEM grid to our samples to locate the same 30 µm x 30 µm area across the techniques used. We then performed correlative microscopy on graphene on sapphire substrate to understand how different features appear with different techniques, including scanning electron microscopy (SEM), micron-scale mapping with Raman spectroscopy, and atomic force microscopy (AFM). We were able to identify how wrinkles in the graphene appear in the three techniques, and better understand areas that appear as darker contrast in SEM in-lens (SE1) images.

References

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