Morphology and nano-manipulation of covalently grafted layers on graphene and graphitic substrates: a step towards graphene-based integrated circuits

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Abstract

Covalent grafting by reactive radicals opens up exciting possibilities to modify and tune graphene properties and structure: from highly conductive pristine graphene to electrical insulators- graphane, perfluorographane, and the like. Thus, the seamless integration of nanopatterned graphene and graphane was predicted to create powerful platform for different devices.[1] The full realization of graphene-based electronics requires high level of control over graphene structure and functionalization all the way down to the nanometer scale. Unfortunately, many techniques that can confirm successful covalent grafting do not have necessary spatial resolution at nanoscale, and as a result, the progress in nano-structuring of covalently grafted graphene and graphitic surfaces has been slow.

In this work we show how scanning tunneling microscopy (STM) can be used for direct visualization of covalently grafted sites. Focusing on aryl-grafting of graphene and highly oriented pyrolytic graphite (HOPG), we were able to not only visualize and characterize covalently grafted sites, but also to develop rationale for the design and fabrication of highly dense, uniform aryl-grafted monolayers. Furthermore, we demonstrated that scanning probes (STM and AFM) could be used to selectively break grafting bonds efficiently restoring defect-free sp^2-carbon network of graphene with nanometer precision. This important finding allows for quick prototyping of complex graphene architectures via scanning probe lithography.

References

[1] A. K. Singh and B. I. Yakobson, Nano Lett., **9** (2009) 1540.

Figures