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Self-Assembled Monolayers as Templates for Linearly Nanopatterned Covalent Chemical Functionalization of Graphite and Graphene Surfaces

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Dimensionally confined carbon nanomaterials play an important role in sustainable science and technology. Here we present a new approach for nanoscale covalent functionalization of graphite surfaces employing self-assembled molecular monolayers of n-alkanes as templating masks. Linearly aligned aryl groups with a lateral periodicity of 5 or 7 nm are demonstrated utilizing aryldiazonium chemistry as covalent functionalization method in combination with the molecular templates of different spatial periodicities (figure 1).[1] The key feature of this approach is the use of a phase separated solution double layer consisting of a thin organic layer containing template molecules topped by an aqueous layer containing aryldiazonium molecules capable of electrochemical reduction to generate aryl radicals which bring about surface grafting. This protocol was demonstrated to be applicable to linear grafting of graphene and hence provides an alternative approach towards rationally designed nanoscale materials.

References

[1] K. Tahara, T. Ishikawa, B. E. Hirsch, Y. Kubo, A. Brown, S. Eyley, L. Daukiya, W. Thielemans, Z. Li, P. Walke, S. Hirose, S. Hashimoto, S. De Feyter and Y. Tobe, ACS Nano, 12, 11 (2018), 11520-11528

Figures

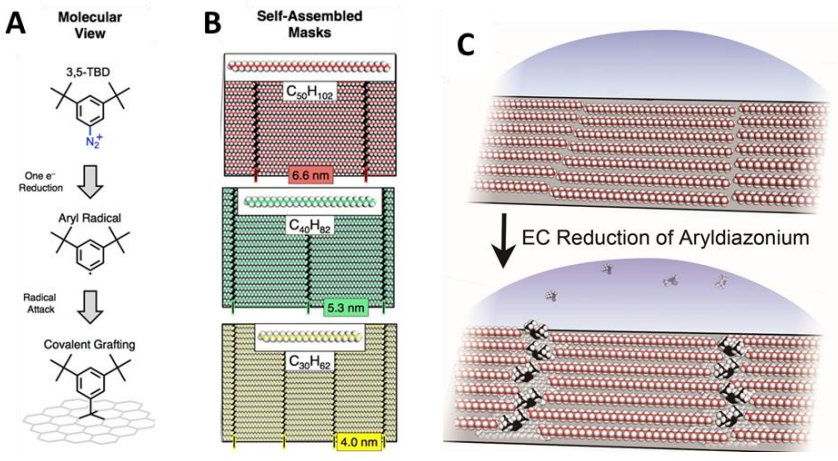

Figure 1: A) The aryldiazonium chemistry used for covalent functionalization, B) The self-assembled alkane masks with various periodicities serving as molecular templates for C) the spatial structuring of grafted aryl groups on the carbon substrate surface.