Light-triggered covalent patterning on graphene: Toward the fabrication of novel graphene substrates

Muhammed Shameem K. M.[a]
Guilin Feng,[b] Kunal Mali,[a] Steven De Feyter,[a] and Hiroshi Uji-i.[a&b]
[a] *Division of Molecular Imaging and Photonics, Department of Chemistry, KU Leuven, Celestijnenlaan 200F, Belgium 3001*
[b] *Research Institute for Electronic Science (RIES) and Division of Information Science and Technology, Graduate School of Information Science and Technology, Hokkaido University, N20W10, Sapporo, Hokkaido 001-0020, Japan.)*
Muhammedshameem.km@kuleuven.be

Abstract

Recent years have witnessed great efforts to access chemically patterned graphene substrates by exploiting existing, yet newly introduced surface pattering methodologies such as laser writing, resists-assisted lithography, and spatially controlled self-assembly. The spatially controlled molecular patterning on graphene surfaces has led to the fabrication of several prototype substrates including Janus and hybrid superlattices, heterostructures, multicomponent interfaces, and hierarchical assembly, for multipurpose nanoscale device applications.[1,2] In our lab, we have employed the Laser Direct Writing (LDW) technique to chemically pattern the monolayer graphene in a reversible fashion.[3] The LDW technique enables the spatially controlled addition of different functional groups, such as hydroxy, methyl, methoxy, acetate, and phenyl derivatives on the desired locations with controlled grafting density. In addition to molecular writing and reading, the same laser has also been used for the selective desorption of the functional group, enabling reversible chemical patterning. Laser-induced degrafting removes the addend from the graphene surface and yields the re-establishment of the pristine structure (sp3 to sp2). The lateral resolution of the photo-driven molecular attachment/desorption in our case is limited only by the diffraction limit of the light source being used. The photo-patterning and desorption of the molecule have been characterized using time-dependent Raman and AFM techniques. Furthermore, chemically patterned graphene substrates have been effectively employed to enhance Raman signals from organic dye molecules.[4]

References

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