Diazonium-Modified Laser-Irradiated Graphene: A Competitive Material for Flexible Electronics

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Graphene-based nanostructures attract the wide audience's attention since their discovery. Nevertheless, materials with tunable properties are still in high demand. One of the most relevant materials in this regard is graphene oxide (GO). The benefits of the substance are obvious: hydrophilicity, mechanical stability, and multiple ways to adjust the conductivity values, starting from chemical treatment to heating and laser reduction. These approaches allow regulating the amount of remaining oxygen containing groups. Although none of the reduction methods result in graphene as a final product, as some of the groups still remain forming not graphene but reduced graphene oxide (rGO). In this regard, we are aiming at a new competitive material fabrication, which will provide the outstanding properties including better conductivity and sensitivity in order to exploit the advantages in optoelectronics, sensors, and biomedical applications.

In this work, we demonstrate the method of diazonium functionalized graphene sheets fabrication with a help of electrochemical exfoliation of graphite in the presence of diazonium salts[1] (herein called Mod-G), and the following laser modification of material (LMod-G). The obtained Mod-G powder was diluted in a solvent (polar or non-polar depending on the used salt). Mod-G forms insulating films on arbitrary substrates. Laser irradiation performs the elimination of aryl groups from the structure. LMod-G demonstrates high electrical conductivity, mechanical robustness, and water stability.

For the comparison to GO, we fabricated two identical breath sensors based on rGO and LMod-G circuits. The sensors were tested simultaneously in the same environment. As the result, LMod-G sensor showed more than 100% higher sensitivity than the GO-based one. Moreover, we were constantly monitoring the current stability, which was about 98% for several weeks.

The new presented material has a potential for the application in all kinds of flexible electronic devices.

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References

[1] Englert, J. M. et al., Nat. Chem. 3, 279–286 (2011)

Figures

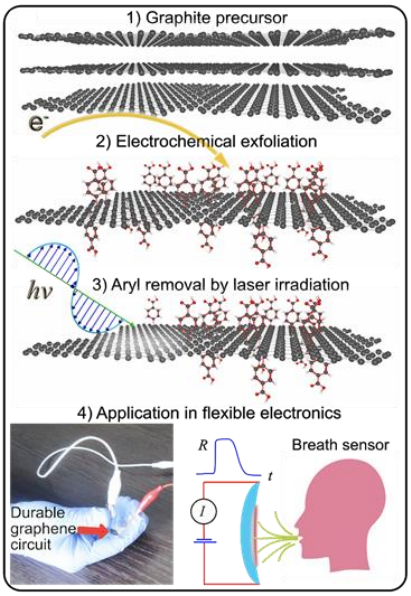

Figure 1: The scheme of LMod-G fabrication and its practical demonstration as a breath sensor