References

1. *Schepetkin I.A., Khlebnikov A.I., Potapov A.S., Kovrizhina A.R., Matveevskaya V.V., Belyanin M.L., Atochin D.N., Zanoza S.O., Gaidarzhy N.M., Lyakhov S.A., Kirpotina L.N., Quinn M.T. // European Journal of Medicinal Chemistry, 2019.– V.161.– P.179–191.*
2. *Solinas G., Becattini B. // Molecular Metabolism, 2017.– V.6.– P.174–184.*
3. *Koch P., Gehringer M., Laufer S.A. // Journal of Medicinal Chemistry, 2015.– V.58.– P.72–95.*
4. *Cuenda A., Rousseau S. // Biochimica et Biophysica Acta (BBA) – Molecular Cell Research-Biochim., 2007.– V.1773.– P.1358–1375.*
5. *Stankevich K.S., Schepetkin I.A., Goreninskii S.I., Lavrinenko A.K., Bolbasov E.N., Kovrizhina A.R., Kirpotina L.N., Filimonov V.D., Khlebnikov A.I., Tverdokhlebov S.I., Quinn M.T. // ACS Biomaterials Science & Engineering, 2019.– V.5.– P.5990–5999.*

DIAZONIUM-FUNCTIONALIZED LASER-IRRADIATED GRAPHENE AS A MATERIAL FOR FLEXIBLE AND WEARABLE ELECTRONICS

A. Lipovka, A. Khalelov, P. Postnikov, E. Dorozhko, E. Sheremet

Scientific advisor – Ph.D., professor R. Rodriguez

National Research Tomsk Polytechnic University

634050, Russia, Tomsk, 30 Lenin Avenue, aal26@tpu.ru

Graphene and carbon nanostructures are widely spread nowadays for the use in electronic devices fabrication. However, graphene itself could be strained to use for the aims of flexible electronics and the Internet of Things due to the poor dispersibility in solvents (except the toxic ones) and its bad reinforcement to polymers. In this regard, a material capable to overcome these issues is one of the graphene derivatives – graphene oxide (GO). GO forms stable water and ethanolic suspensions and is convenient to be used in water-processable deposition techniques on arbitrary substrates. Multiple ways, which are globally divided into thermal and

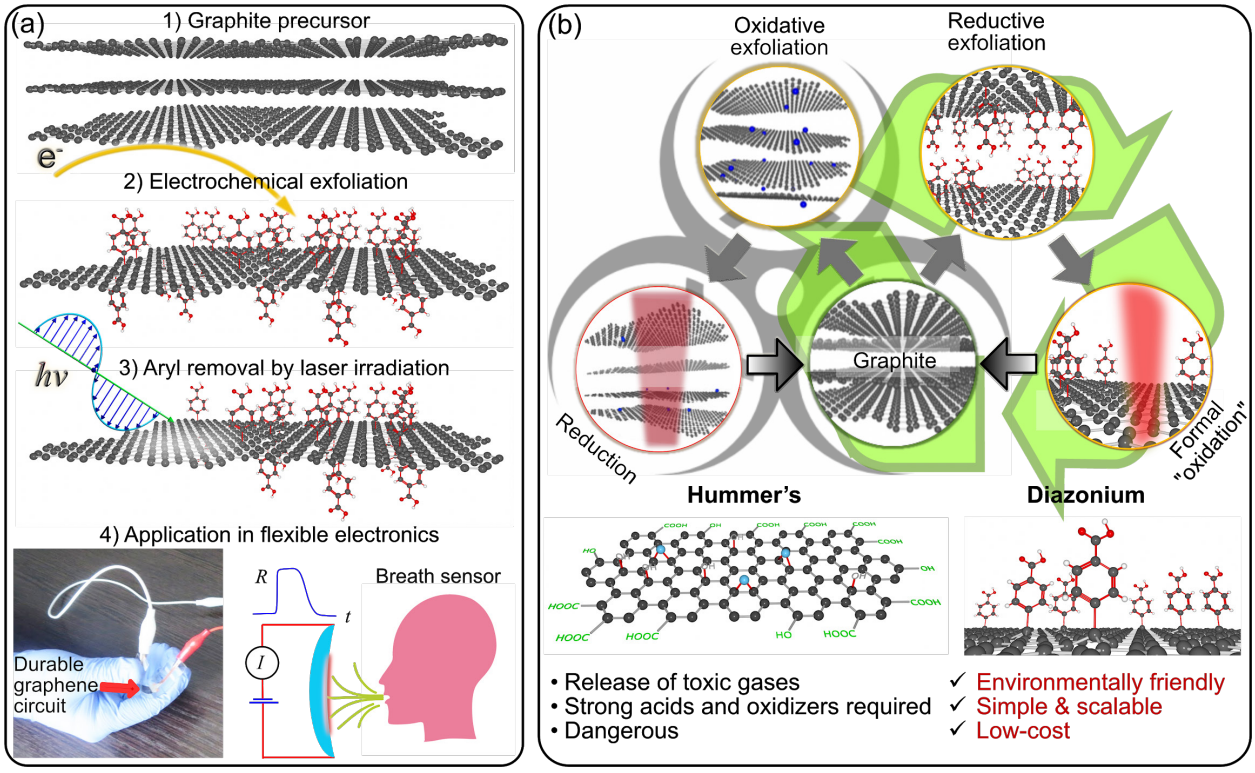

Fig. 1.

chemical approaches, have been proposed to convert GO to an electrical conductor.

In our group, we use the local thermal effect in the form of high power laser irradiation to remove the structural oxygen groups and control electrical conductivity. This way we also perform patterning with the desired geometry, contrary to the cases of other methods [1].

However, GO also is suffering from several disadvantages. Harsh oxidation produces vacancy defects that could not be removed completely following any reduction pattern [2]. What is more important, mechanical robustness of rGO on flexible substrates is insufficient, which limits its applications in sensors and wearables. Hereby we propose a green, scalable and easy-to-perform method of synthesis of graphene functionalized with aromatic compounds (ModG). We developed a way of bulk graphite electrochemical exfoliation with simultaneous diazonium functionalization. ModG demonstrates highly hydrophilic behavior and could be used as a GO alternative in terms of films fabrication on multiple substrates, including flexible ones.

In the same way, as for GO, we used a laser irradiation approach to remove aryl functionalization. Noticeably, resulting material (LModG) demonstrates higher conductivity values compared to rGO prepared under the same conditions [3].

We performed a full characterization of ModG and LModG films on glass and polymer substrates. Contact angle experiment results indicated a drastic change in wettability after laser treatment, which indirectly demonstrates a successful removal of functional groups, which was also proved using IR spectroscopy. X-ray diffraction and Raman spectroscopy showed a high ModG crystallinity. Atomic force microscopy showed a thickness and conductivity of single layers.

An especially important finding is that ModG laser treatment on polyethylene terephthalate (PET) leads to the fabrication of not only conductive but highly mechanically robust structures. X-ray photoelectron spectroscopy data prove our theory that local temperature treatment leads to a formation of LModG/PET composite structure. Therefore this water and scratch-resistant material shows a high potential for the use in flexible electronics.

For now, LModG was used for the fabrication of chemical, electrochemical, skin conductance and bending sensors.

References

1. *V. Prakash, R.D. Rodriguez, A. Al-Hamry, A. Lipovka, E. Dorozhko, O. Selyshchev, B. Ma, S. Sharma, S.K. Mehta, V. Dzhagan, A. Mukherjee, D.R.T. Zahn, O. Kanoun, E. Sheremet // Analyst., 2019.– 144.– 3297–3306.*
2. *T. Kuila, S. Bose, A.K. Mishra, P. Khanra, N.H. Kim, J.H. Lee // Progress in Materials Science, 2012.– 57.– 1061–1105.*
3. *R.D. Rodriguez, A. Khalelov, P.S. Postnikov, A. Lipovka, E. Dorozhko, I. Amin, G.V. Murastov, J.-J. Chen, W. Sheng, M.E. Trusova, M.M. Chehimi, E. Sheremet // Materials Horizons, 2020.– 119.– 5461.*

ASSESSMENT THE THERMODYNAMIC PROBABILITY OF AROMATIC HYDROCARBON FORMATION REACTIONS OCCURRENCE UNDER THE CONDITIONS OF n-HEXANE ZEOFORMING

K.E. Mardanov, I.A. Bogdanov
Scientific adviser – PhD, associate professor M.V. Kirgina
Linguistic advisor – PhD-student I.A. Bogdanov

National Research Tomsk Polytechnic University
634050, Russia, Tomsk, 30 Lenin Avenue, kananmar8@mail.ru

Production of high environmental classes motor fuel components requires to reduce the content of aromatic hydrocarbons in them and increase the content of hydrocarbons with isostructure, which also increase the octane number of fuel.