LASER PROCESSING FOR THE MANUFACTURING OF BIOCOMPATIBLE/BIODEGRADABLE FLEXIBLE ELECTRONICS[1]

E. SHEREMET, I. PETROV, M. FATKULLIN, I. BRIL', E. DOGADINA, E. ABYZOVA, D. CHESHEV, A. AVERKIEV, K. BRAZOVSKIY, R.D. RODRIGUEZ

Tomsk Polytechnic University, Lenin ave. 30, Tomsk, 634050. Russia

Carbon nanomaterials and their composites are widely employed to manufacture biocompatible electronics, for example for so-called electronic tattoos. They are characterized by large surface area, relatively low cost, good conductivity, chemical stability, mechanical strength, and flexibility. However, flexible electronics face important challenges of ensuring mechanical stress and creating well-defined patterns for realizing a variety of electronic components while providing needed electronic properties. To address all these issues, we propose laser-induced integration that leads to the formation of conductive carbon-polymer composites locally under the laser spot.

In this report, we discuss the mechanism of laser-induced composite formation due to graphene oxide (GO) reduction and reduced GO (rGO) intermixing with the polymer substrate acting as a flexible matrix. GO film is deposited on thermoplastic polymer substrates and dried, then it is illuminated with a microsecond-pulsed laser. The laser radiation is locally absorbed by the dark GO film, heating the sample. We found several regimes depending on the laser power, leading to rGO/polymer intermixing, polymer destruction, and/or rGO ablation [1]. This approach allows us to create mechanically robust conductive structures working as electrochemical electrodes [2], resistors, and capacitive and inductive components. We also discuss the prospects for creating basic logic components - diodes and transistors - based on our experimental data.

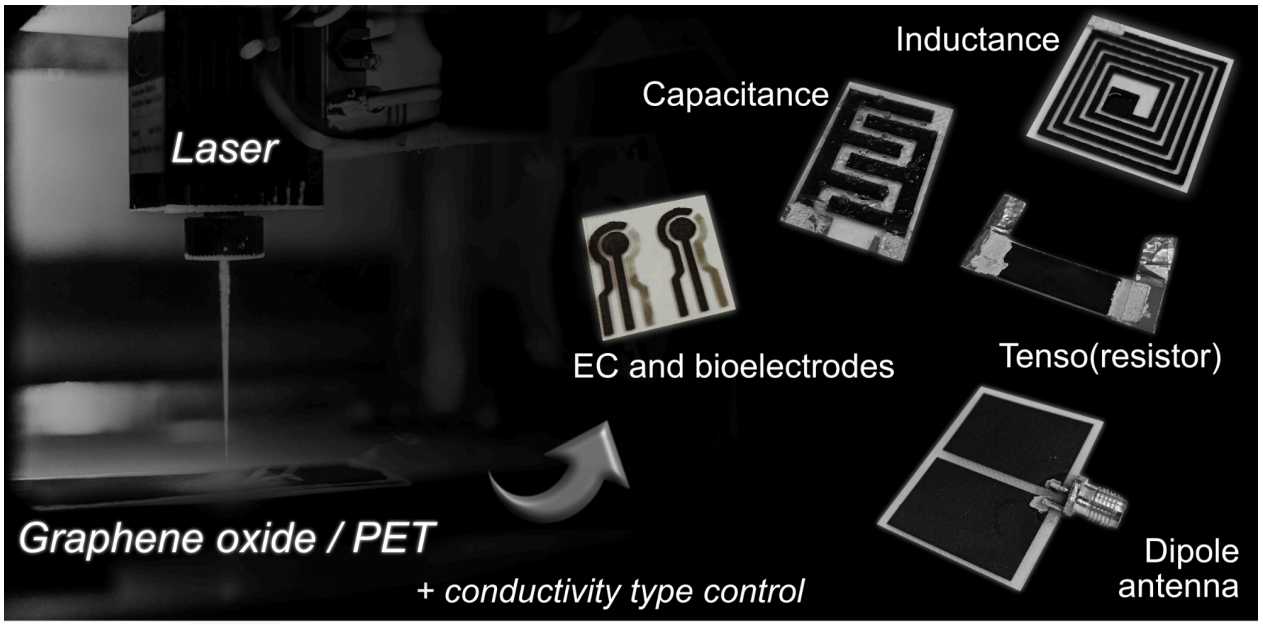

Figure 1. Basic components of flexible electronic circuits made of GO.

REFERENCES

[1] Abyzova E, Petrov I, Bril' I, Cheshev D, Ivanov A, Khomenko M, et al. Universal Approach to Integrating Reduced Graphene Oxide into Polymer Electronics. Polymers. 2023;15. doi:10.3390/polym15244622

[2] Fatkullin M., Dogadina E., Bril' I., Ivanov A., Matkovic A., Rodriguez R.D., Sheremet E. Nanomaterials/Polymer-Integrated Flexible Sensors: A Full-Laser-Processing Approach for Real-Time Analyte Monitoring. IEEE Sensors Journal. 2024; accepted.

[1] The work was supported by the Russian Science Foundation grant № 22-12-20027 and funding from the Tomsk region administration. "Electronic components based on laser integration for the biocompatible/biodegradable flexible electronic devices".