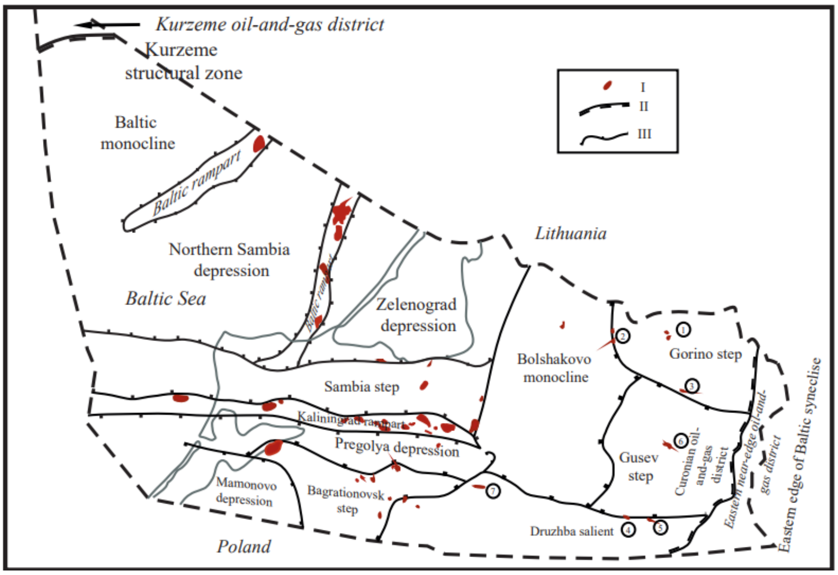

Fig. 1. *Tectonic and geological oil-and-gas zoning of Kaliningrad region [1]: (I) oil fields; (II) boundaries of first-order structural units; (III) boundaries of second-order structural units. Oil fields: (1) Vostochno-Gorinskoye; (2) Novo-Iskrinskoye; (3) Novo-Serebryanskoye; (4) Sechenovskoye; (5) Ryazanskoye; (6) Gusev deposit (Ordovician); and (7) Druzhbinskoye*

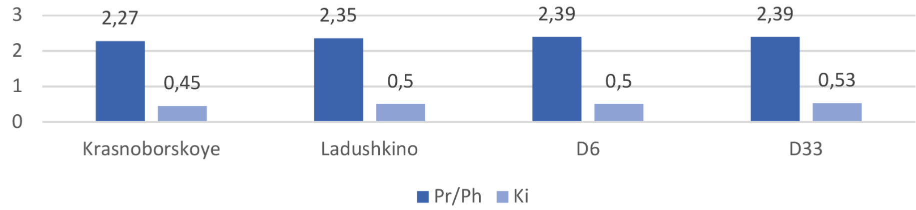

Fig. 2. *GC-MS results*

The conducted research for the first time examines the origin of the D33 offshore and Ladushkinskoye onshore fields that is important in order to understand their genesis and possible routes of processing.

References

1. *Okhotnikova E. S.,Yusupova T. N., Barskaya E. E., Ganeeva Yu. M., Mukhametshin R. Z. Geochemical analysis of crude oils in kali-nin-gradoblast oil fields and its importance for oil production. Petroleum Chem., 2021. – 61 (9): 994–1000.*

PROPERTIES AND DEGRADATION OF rGO/PLA LASER-INDUCED COMPOSITES TOWARD IMPLANTABLE ELECTRONICS

Е. Г. Абызова, Е. Догадина, И. С. Петров, Е. Н. Больбасов,
А. О. Воробьев, Е. В. Плотников, Р. Д. Родригес
Научный руководитель – PhD, профессор ИШФВП Е. С. Шеремет

ФГАОУ ВО Национальный Исследовательский Томский Политехнический университет
Россия, Томск, проспект Ленина, 30, abyzovaeg@gmail.com

The need for implants to support tissues and organs, for monitoring and for neurostimulation, has been increasing every year. When traditional diagnostic methods like X-rays and MRI don't work, implant installation becomes necessary. The challenge in such cases is assessing the condition of the implant itself and of the surrounding tissues to diagnose inflammation or implant failure. Embedding sensors in its surface may enable remote monitoring and thus facilitate doctors' work while providing patients with a sense of security [1]. Biodegradable materials have additional benefits by eliminating the need for extraction and disposal. However, developing materials for such devices that meet both functional and safety requirements is a significant challenge.

Carbon nanomaterials, such as graphene, graphene oxide, reduced graphene oxide, and carbon nanotubes, have recently gained popularity in biomedical research and development due to their unique properties. They are useful in drug/gene delivery systems, cancer therapy, antiviral activity, and biosensing [2]. A cost-effective and readily available type of carbon nanomaterial is graphene oxide, which is capable of producing adaptable structures suitable for use in water-based environments. With its abundant functional groups, it can fix enzymes in place and regulate surface attributes. By reducing graphene oxide, it becomes conductive, much like graphene.

A proposed solution to the challenge of monitoring implant conditions is to use rGO with a biodegradable polymer to develop an electronic component for wireless monitoring. The laser reduction process of graphene oxide will be used to create the electronic component with the desired shape. The potential of this technology to enhance patient care while minimizing its adverse impact on the environment is substantial. However, the development of suitable materials that fulfill both functional and safety requirements remains a crucial issue.

In order to achieve successful integration with reduced graphene oxide, a biodegradable polymer substrate, namely polylactic acid (PLA), was chosen. The process involves applying a GO solution to 3D polymer scaffolds made of PLA, which was then reduced with a 405 nm laser [3]. The resulting rGO/PLA composite was stable even after exposure to mechanical action, water, alkaline and acidic environments.

Toxicity and biocompatibility of samples was tested by subjecting rGO/PLA samples sterilized and placed in buffer solution and culture medium for 0, 1, 7, 15, 30, 60 and 120 days at 37 °C. According to the test results, cell growth took place on the surface of all samples and the cells continued to be viable. Additionally, no toxic substances were released from the films and there was an absence of bacterial growth. This work shows that these newly developed biodegradable electronic components could enable the monitoring of "smart" biodegradable implants within the human body.

The work was supported by Russian Science Foundation grant № 22-12-20027, https://rscf.ru/project/22-12-20027/ and the funding from Tomsk region administration.

References

1. *Artico J., Zecchin M., Zorzin Fantasia A., Skerl G., Ortis B., Franco S., Albani S., Barbati G., Cristallini J., Cannata'A., & Sinagra G. // Journal of Cardiovascular Medicine, 2019. – 20 (8). – 542–550.*
2. *Parand R. Riley, Roger J. Narayan // Current Opinion in Biomedical Engineering, 2021. – Vol. 17. – 100262.*
3. *Murastov G., Bogatova E., Brazovskiy K., Amin I., Lipovka A., Dogadina E., Cherepnyov A., Ananyeva A., Plotnikov E., Ryabov V., Rodriguez R. D., & Sheremet E. // Biosensors & Bioelectronics, 2020. – 112426. – 166.*