IMMUNOSENSING PLATFORM BASED ON ZnO-POLYACRYLONITRILE NANOFIBERS FOR CANCER BIOMARKER DETECTION

Tamashevski A.V.[1], Harmaza Y.M.[1], Iatsunskyi I.[2], Bechelany M.[3]

[1] Institute of Biophysics and Cell Engineering of National Academy of Sciences of Belarus, Minsk, Belarus
[2] NanoBioMedical Centre, Adam Mickiewicz University in Poznan, Poznan, Poland
[3] European Institute Des Membranes, Montpellier, France

Early detection of cancer in patients is an on-going challenge, which can provide a suitable starting point for developing new strategies of tumors treatment. Low-cost, rapid, and label-free detection, as well as portability, are some of the hurdles that need to be overcome. In this regard, it is important to develop novel nanostructures that could be applied for the design of effective biosensing platforms. One-dimensional (1D) ZnO nanostructures have attracted attention due to their potential use as the building blocks in fabricating nanoscale devices.

Cancer biomarkers are molecular indicators of a biological status of the cell. Many types of important antigens on cell surfaces (clusters of differentiation – CD) indicate the presence of a wide variety of disease states. For instance, the accumulation of $CD19^{+}CD5^{+}$ lymphocytes indicates the chronic lymphocytic leukemia. Therefore, the development of sensitive, rapid, and simple methods for CD-biomarker detection has a great diagnostic value.

Optical immunosensors, which are portable, compact and compatible with computerized devices and are characterized by low limit of detection, could be a best solution among the others. In recent works, our project partners and we have demonstrated the possibility of application of nanostructured photoluminescence (PL) immunosensors based on ZnO nanorods for the toxins and cancer cells determination [1-3].

In the present research, we have applied ZnO-polyacrylonitrile (ZnO-PAN) nanofibers as a PL platform for development of immunosensor toward CD-biomarkers detection. As model objects, two types of commercially available proteins (CD5, CD19), and consequently their antibodies (anti-CD5, anti-CD19), were used in biosensing experiments. The formation of antigen-antibody complex was investigated by the determination of changes in ZnO PL. It was developed and established optimal antibodies immobilization methods on the surface of ZnO using three different approaches (with and without protein A/G linking). Some aspects of the mechanism of interaction between antigens and functionalized ZnO-based immunosensors have been also proposed.

This research was funded by MSCA-RISE - Marie Skłodowska-Curie Research and Innovation Staff Exchange (RISE) through the "Novel 1D photonic metal oxide nanostructures for early stage cancer detection" project, grant number 778157.

References

1. R. Viter et al., Analytical, thermodynamical and kinetic characteristics of photoluminescence immunosensor for the determination of Ochratoxin A // Biosensors and Bioelectronics V. 99. 2018. P. 237-243.
2. R. Viter et al., Photoluminescence Immunosensor Based on Bovine Leukemia Virus Proteins Immobilized on the ZnO Nanorods, Sensors and Actuators B: // Chemical 285 (2019) 601-606.
3. A. Tamashevski et al., Zinc oxide nanorod based immunosensing platform for the determination of human leukemic cells // Talanta V. 200. 2019. P. 378-386.