**Increasing of the Nanowire FET Biochip Sensitivity to Virus Particles Using Dielectrophoresis.**

Alexandr Safatov1\*, Vladimir Generalov1, Konstantin Generalov1, Galina Buryak1,

Olga Naumova2, Boris Fomin2, Elza Zaitseva2

*1 Federal Budgetary Research Institution «State Research Center of Virology and Biotechnology “Vector”», Federal Service for Supervision of Consumer Rights Protection and Human Well-Being (Rospotrebnadzor), Koltsovo, Novosibirsk region, 630559, Russian Federation*

*2 A.V. Rzhanov Institute of Semiconductor Physics, Siberian Branch of the Russian Academy of Sciences, Novosibirsk, 630090, Russian Federation*

*\*Corresponding author: safatov@vector.nsc.ru*

**Highlights**

* Biochip architecture including nanowire FETs, dielectrophoresis’ electrodes is developed.
* Dielectrophoresis allows to concentrate antigens in the vicinity of nanowire sensor.
* Concentrating of antigens potentiates the biochip sensitivity.

**1. Introduction**

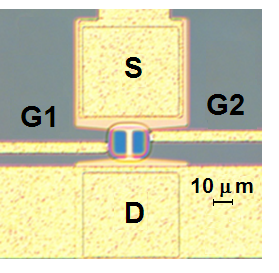
Real time detection of viruses in atmospheric bioaerosol samples may be done using devices based on nanowire FET [1], [2]. Viruses’ concentration in aerosol is very low in some cases. It may lead to missing the viruses in the sample due to insufficient sensor’s sensitivity. Viruses in the measuring chamber volume are distributed randomly. The vicinity of nanowire has a small part of the whole chamber volume and viruses predominantly from this volume easily interact with antibodies on the nanowire. It is proposed to use dielectrophretic forces [3] for viruses’ concentration near nanowire for increasing the nanowire FET biochip sensitivity.

**2. Methods**

Preliminary experiments were conducted using vaccinia virus (LIVP strain was obtained from the FBRI SRC VB “Vector”’s Governmental Collection of viruses) stained with FITC dye (Thermo Fisher, USA) at room temperature. A droplet (volume of about 1 μL) of suspension with low virus concentration was placed between electrodes and luminescent particles behavior was observed using dark field microscope Stemi 2000 (Zeiss, Germany). Vaccinia virus is one of the largest viruses (its dimension is about 400 nm), so its movement may be readily seen under optical dark field microscope.

**3. Results**

Biochip architecture including as 12 nanowire FETs as electrodes for dielectrophoresis at each nanowire FET is developed, Figure 1. Preliminary experiments showed that viruses can be effectively concentrated by dielectrophoresis near the electrodes, Figure 2. One of these electrodes is nanowire itself.



**Figure 1.** Top view of biochip’s fragment. S – FET’s source, D - FET’s drain and nanowire between them; G1 and G2 - electrodes for dielectrophoresis.

А

**Figure 2.** Distribution of vaccinia viruses (bright white dots) between perpendicular electrodes Left – no electric field applied. Right – electric field applied with frequency 200 kHz, voltage amplitude 5 V.

**4. Conclusions**

The results obtained visually demonstrates the possibility of viruses in bioaerosol samples to be concentrated near nanowire sensor. So the sensitivity of biochip may be increased using dielectrophoresis.

**Acknowledgement**

This work is supported by the Russian Science Foundation for Basic Research project # 18-29-02091\18 (in part of designing of biochip topology and calculation of electrical field parameters in it) and by state assignment GZ-11/16 (in part of concentration of viruses).

**References**

1. Shen, F., et al. (2011). Environ. Sci. Technol., 45, 7473–7480.
2. Park, K.-T., Cho, D.-G., Park, J.-W., Hong, S. & Hwang, J. (2015). Sci. Reports, 5, paper 17462.
3. Generalov et al. Dielectrophoresis in diagnostics of infectious and noninfectious diseases, Ceris, Novosibirsk, 2011. (In Russian)