# Vertically Aligned Carbon Nanotubes Modified by Ion Beam as a Bioninterfaces for Bacteria

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## INTRODUCTION

The biological interaction of carbon nanotubes with biological objects can have a negative impact<sup>1</sup>. The type of exposure is a consequence of the structural features and sizes of nanotubes. Particularly interesting is the biological effect of carbon nanotubes modified with an ion beam<sup>2</sup>.

### **EXPERIMENTAL STUDY**

Vertically oriented multi-walled carbon nanotubes were synthesized by the CVD method<sup>3</sup> in a muffle furnace in an  $N_2$  atmosphere, while acetylene was passed in a mixture with a ferrocene catalyst. Multi-walled nanotubes were deposited on a silicon substrate. Ion implantations were performed at the accelerator facility HVEE-500<sup>4,5</sup>, which allows obtaining ions in a wide range of masses (from 1 to 250 amu) and energies up to 500 keV for single charged ions.

For the preparation of suspensions, the preparation "Colibacterin dry" - "Microgen" (strain E-Coli M-17).

The 0.015 g of samples were introduced into test tubes with bacteria; for each sample, two test tubes with dilutions of  $10^{-7}$  and  $10^{-10}$ , respectively. In addition to test tubes with test samples, there were two tubes: with culture control and with environmental control. After entering the samples, all tubes were placed in a thermostat (TS-1/80 SPU) for 24 hours at a temperature of + 37°C. After 24 hours, optical density and spectrometry of the obtained daily bacterial cultures were measured.

Three samples were studied in the work: No. 1-3, which have different structural and surface properties. In particular, No. 1 and No. 3, unlike FP - No.2, practically do not contain a loose carbon film on the surface, and the No. 1 sample has the cleanest surface

#### **RESULTS AND DISCUSSION**

In the measurement (Fig. 1) range from 300 to 1100 nm, the following features were noted. For all three samples, the presence of two peaks at a wavelength of 460 and 415 nm is recorded. These peaks correspond to the presence of pyruvate dehydrogenase (460 nm) and trianine deaminase (415 nm) enzymes in the studied suspensions. Both enzymes are involved in the metabolic processes of bacteria. As a result of the measurements, we can conclude that there is no negative effect of samples No. 1 and 3 on bacterial growth. we can conclude that samples of vertically oriented carbon nanotubes with hydrophobic surface properties have a more favorable biological interaction on vital activity of bacteria E. Coli strain M- 17. As a result, we can talk about positive bacterial biocompatibility of samples No. 1 and No. 3 E. Coli M-17.



Fig. 1 Optical absorption spectrum of a bacterial suspension grown in the presence of three samples

## CONCLUSION

The structure and composition of the surface can be effectively controlled by ion irradiation. Metabolic processes in bacterial culture are manifested more actively in the presence of hydrophobic samples of nanotubes.

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