Nanotube based biosensor for accurate thrombin detection on flexible substrate

Komarov I.A.[1], Bobrinetsky I.I.[1], Golovin A.V.[2], Zalevsky A.O.[2]

1 National Research University of Electronic technology, Russian Federation (bobrinet@mail.ru)
2 Moscow State University, Russian Federation (aozalevsky@gmail.ru)

Biological sensors is a promising area of nanomaterials applications. Single wall carbon nanotubes (SWCNT) have high specific surface area as well as high sensivity to environment which make them applicable as interface between biological targets and electronic devices [1]. In that case a signal from small biological objects could be taken in easy-to-use form.

In the present work we describe assembly of high-sensitive biosensor at flexible substrate sensitive to human thrombin - key protein of blood coagulation cascade. We showed consistency of sensor response results with those obtained by molecular dynamics simulations and quantum mechanics calculations. SWCNT were modified with thrombin binding aptamer to form a sensitive layer on a flexible substrate. Formation of aptamer-protein complex changes aptamer conformation which affects charge distribution on nanotube's surface and results in changes of sensor resistance. As we showed the resistance of the structure decreased in ~ 45%. Reaction time is about 100 seconds. We used albumin protein as a control sample. The resistance decreased in 16% that is much less than response on thrombin.

Combination of experimental and computational methods gives deep understanding of underlying mechanisms which is crucial for successful development of highly specific highly sensitive sensors based on unique features of aptamers and single wall carbon nanotubes. These is the first time the carbon nanotube-based aptasensor was made on flexible substrate.

[1] Chengguo Hu, Shengshui Hu. Carbon Nanotube-Based Electrochemical Sensors: Principles and Applications in Biomedical Systems. Journal of Sensors, Volume 2009, Article ID 187615, 40 pages, doi:10.1155/2009/187615