Immunology Interfaces with Nanotechnology: The Development of a Sensitive Carbon Nanotube-Based Biosensor for the Detection of Influenza A (H1N1)

Cummings, Benjamin (School: Pittsburgh Allderdice High School)

The seasonal Influenza A virus (H1N1) remains a highly contagious and deadly disease worldwide. Rapid sensitive testing options remain limited. Although success has been found in methods such as molecular assays and nucleic acid amplification, the disruptive discovery of carbon nanotube (CNT) implementations of field-effect transistors (FETs) has allowed for unprecedented rapid and sensitive detection of pathogens. Simple resistor implementations of antibody functionalized CNTs have already proven to be effective sensors of the influenza virus (H1N1). The purpose of this research is to develop a novel biosensor for the detection of human H1N1 virus using an antibody-functionalized CNTFET, enhancing previous work. The sensor utilizes carbon nanotubes as transducers for the binding reaction between an anti-hemagglutinin antibody and the hemagglutinin viral surface protein. Through a series of chemical and mechanical syntheses, the antibody was functionalized onto the surface of a carbon nanotube FET, where it was used to detect the presence of viral particles in solution via liquid-gated sensing. Current-voltage measurements across the surface matrix were recorded after the application of the particles, with varying concentrations. The presence of the antibodies coupled on the CNT interface was also determined using advanced microscopy. The concentration of hemagglutinin presented to the device demonstrated a relatively strong logarithmic correlation with the relative change in maximum current, with respect to the blank. The sensor also produced a negligible response when tested against negative biological controls, showing proof of selectivity. This work provided the first step towards the development of a rapid sensitive point-of-care breathalyzing clinical test.