Optical detection of viruses with silver nanowires

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Sensitive detection of viruses has been considered recently as one of the most interesting and attractive research fields. The driving force behind these efforts is a need to prevent incubation and spreading of diseases among humans, animals, and plants. Binding of specific antibodies to targeted antigens is perhaps the most popular of all biosensor designs [1].

Since viruses labeled with fluorescent dyes are rather very small objects (20-300 nm) they cannot be directly observed using an optical microscope, however we can apply other nanostructures as “fishing rods” to detect them. While silver nanostructures have already been used to detect viruses [2], our idea was to apply silver nanowires as a geometric platform to hitch on antibodies and detect viruses by combining fluorescence and optical microscopy.

In our research [3,4] we used two different bacteriophages: T7-SYBRGreen-intercalated and T4-SYTO62-intercalated. First bacteriophages are specific and the second are not-specific with respect to the antibody. In the case with unmodified AgNWs there is no clear position correlation between the nanowires and the fluorescence spots (even for overnight incubation). Thus no specific interaction between viruses and nanowires took place. In contrast, for specifically functionalized AgNWs, where antibodies were attached that can bind T7-SYBRGreen intercalate bacteriophages, we observe clear correlation between these two images, as shown in Fig. 1. This effect is the most apparent after overnight incubation. We conclude that fluorescence microscopy imaginig indicates conjugation of the silver nanowires modified with antibodies via specific interaction with T7-SYBRGreen intercalate bacteriophages. In many instances attachment of single wiruses can be demonstrated. We belive that such an architecutre based on silver nanowires can be used for effective virus detection.

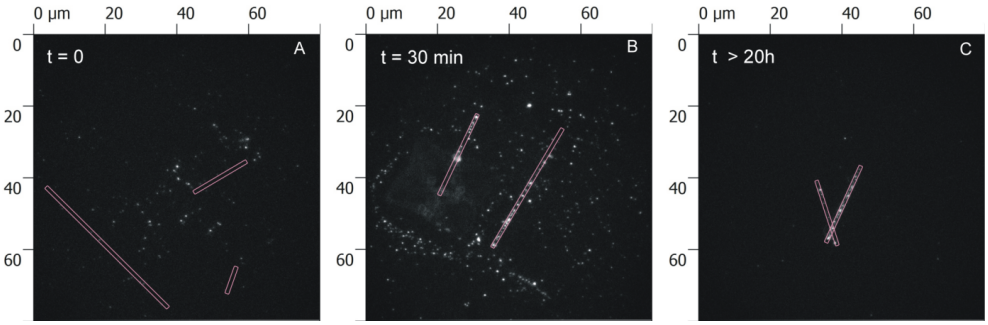

Fig. 1 Fluorescence intensity maps obtained using wide-field fluorescence microscopy for T7-SYBRGreen intercalate bacteriophages mixed with AgNWs modified with anti-T7-tag antibodies after t = 0 (A), t = 30 min (B), t > 20 h (C). For excitation we used wavelength of 485 nm.

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