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High sensitive virus and bacteria detection using plasma-surface-functionalized and antibody-integrated carbon nanomaterials[1]

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In this study we will present our recent results on the virus and bacteria detection system using the surface-functionalized carbon-encapsulated magnetic nanoparticles (NPs) fabricated by dc arc discharge, and carbon nanotube(CNT) dot-array prepared with a combined thermal and plasma CVD system. Surface functionalization of their surfaces has been carried out by plasma chemical modification using a low-pressure RF plasma for carbon-encapsulated magnetic NPs, and an ultrafine atmospheric pressure plasma jet(APPJ) for CNT dot-array substrate. After immobilization of the relevant biomolecules onto the surface of nano-structured materials, we have carried out the experiments on virus or bacteria detection using these surface-functionalized nano-structured materials. From the preliminary experiments with carbon-encapsulated magnetic NPs, we confirmed that influenza A (H1N1) virus concentration of 17.3-fold was achieved by using anti-influenza A virus hemagglutinin (HA) antibody. We have also confirmed a rapid and sensitive detection of *Salmonella* using the proposed method. The feasibility of CNT dot-array as a microarray biosensor has been studied by maskless functionalization of amino (-NH_2) and carboxyl (-COOH) groups onto CNTs by using a ultrafine APPJ with a micro-capillary. The experimental results of chemical derivatization with the fluorescent dye showed that the CNT dot-array was not only functionalized with amino group and carboxyl group, but was also functionalized without any interference between functional groups. The success of maskless functionalization in the line pattern provides a feasibility of a multi-functionalization CNT dot-array device for future application of a microarray biosensor.

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