Detection of cancer cells using a peptide nanotube–folic acid modified graphene electrode

This article describes the preparation of a graphene electrode modified with a new conjugate of peptide nanotubes and folic acid for the selective detection of human cervical cancer cells over-expressing folate receptors. The functionalization of peptide nanotubes with folic acid was confirmed by fluorescence microscopy and atomic force microscopy. The peptide nanotube–folic acid modified graphene electrode was characterized by scanning electron microscopy and cyclic voltammetry. The modification of the graphene electrode with peptide nanotube–folic acid led to an increase in the current signal. The human cervical cancer cells were bound to the modified electrode through the folic acid–folate receptor interaction. Cyclic voltammograms in the presence of [Fe(CN)$_6$]$_{3/4}$ as a redox species demonstrated that the binding of the folate receptor from human cervical cancer cells to the peptide nanotube–folic acid modified electrode lowered the electron transfer resulting in a decrease in the measured current. A detection limit of 250 human cervical cancer cells per mL was obtained. Control experiments confirmed that the peptide nanotube–folic acid electrode specifically recognized folate receptors. The modified electrode described here opens up new possibilities for future applications in early stage diagnoses of diseases where cells over-express folate receptors, such as in cancer or leishmaniasis disease.

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