Magnetite nanoparticles on paper: A platform for the diagnosis of dengue fever by magnetic-ELISA

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Enzyme-linked immunosorbent assays (ELISAs) are the most widely used methods to detect antibodies. However, they have some drawbacks. As a result, in recent years magnetic nanoparticles or beads (e.g. magnetites) have been combined with ELISAs to improve their analytical performance. On the other hand, despite paper-based ELISA are less sensitive than conventional ELISA, they emerge as suitable platforms to develop disposable devices for point-of-care diagnostic. A novel “magnetic-ELISA”, based on core-shell magnetite@polydopamine nanoparticles supported on Whatman paper was developed to detect IgM-dengue antibodies. An affordable procedure to deposit magnetite nanoparticles on paper surfaces (Whatman type-I and Whatman type-ss903) and, to conjugate such nanoparticles with anti human-IgM antibodies using polydopamine as linker, is reported. Structural features, magnetic behavior, coating homogeneity, as well as, the nanoparticles/linked antibodies ratio were determined. The analytical performance of “magnetic-ELISA” supported on paper surface was 100 times more sensitive with a 700 times lower limit of detection than traditional ELISA or using magnetic beads without depositing on paper to detect IgM-dengue antibodies. Additionally, the new system showed low background, acceptable reproducibility, low-cost, easy manufacturing and effortless and easy handling which are very important, considering the large number of biological samples to be processed by a laboratory in case of dengue epidemics.

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Graphene-edge probes for scanning tunneling microscopy

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Fabrication of freestanding graphene-edge probes for scanning tunneling microscopy was demonstrated. Graphene was prepared by thermal chemical vapor deposition (CVD) from solid carbon sources. A Cu wire acted as the substrate for graphene growth. As the freestanding graphene probes were fabricated, the process was monitored using a micromanipulator and an optical microscope. Our previous study of electron emission patterns from a field emission microscope demonstrated the layered structure of the graphene edge. A single-layer of graphene emitted electrons from a limited number of atoms. We found that the graphene emitters required careful conditioning to achieve a stable emission current. In this research, such activated graphene probes were applied for use in scanning tunneling microscopes for surface morphology detection. The preconditioned, multi-layer graphene probe presented resolution that was comparable to conventional probes. Our study generated a practical method for applying individual freestanding graphene for surface probe microscopy.

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