Diagnostic devices using graphene and other nanomaterials

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Abstract

Development of novel diagnostic tools with interest for point of care applications represents one of the main research fields for the nanobiotechnology. Efforts are shown to either develop brand new devices or improve existing ones thanks to the use of nanomaterials and nanotechnologies. Between the various devices biosensing systems based on electrical or optical transducing schemes are overall in the focus of interest given the simplicity and cost efficiency of detection. Among the various biosensing system performance requirements the high sensitivity and selectivity of the response are crucial for applications in clinical diagnostics. The fulfilment of such requirements means the detection of low levels of clinical biomarkers in human fluids. Given the fact that biomarkers are present in very low concentrations the need for biosensing systems that can detect these analytes with high sensitivity and selectivity that include very low detection limits along with high reproducibility is an important challenge. To overcome the difficulties in accomplishing all these requirements the main efforts are driven toward signal amplification and noise reduction of biosensing systems by the incorporation of nanomaterials. Nanomaterials (NMs) such as carbon nanotubes, graphene, metallic nanoparticles, nanowires and quantum dots are showing to be excellent materials to be used as electrochemical transducers or labels in DNA (or genosensors) sensors beside enzymatic sensors, immunosensors, or cell sensors. The amplification of the detection of biorecognition events (ex. DNA hybridization reactions etc) are the most important objectives of the current bioanalytical chemistry. In this context integration of the catalytic properties of some biomolecules with those of nanomaterials is appearing to be a promising way to enhance the sensitivity of the bioassays. Examples related to various clinical biomarkers as well as contaminants detection will be shown. The developed devices and strategies are intended to be of low cost while offering high analytical performance in screening scenarios beside other applications. Special emphasis will be given to lab-on-a-chip platforms with integrated electrochemical detection with interest for various applications. In addition simple paper-based platforms that operate in lateral flow formats with interest for various detections also will be shown.