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Nanomaterials for Sensor Applications

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Recently, a large part of the advances in nanotechnology have been directed towards the development of high-speed electronics, more efficient catalysts, and sensors. This latter group of applications has great relevance and unprecedented development potential for the coming years. So far, some of the main objectives for the development of sensors have focused on making more sensitive, effective and specific sensing devices. The improvement of these systems and the increase of specificity are clearly associated with a decrease in size of the components, which can lead to obtaining more rapid action, almost in real time. Nanomaterials currently used in sensor development include a long list of nanostructured systems, as for example: Metal nanotubes, nanowires, nanofibers, nanocomposites, nanorods, nanoparticles, nanostructured polymers, and different allotropes of carbon as carbon nanotubes, graphene or fullerenes, among others [1]. These nanomaterials are characterized by having unique physicochemical properties, including high electrical and thermal conductivity, extremely high surface area/volume ratio, high mechanical strength and even excellent catalytic properties [1] [2]. These materials, may exhibit relevant physicochemical behavior, such as quantization or electronic confinement effects, which can be used in the development of all kinds of sensors [2].

So far, sensors have been developed for determination and quantification of gases, radiation, biomolecules, microorganisms, etc. [2] [3]. The sensors developed so far usually use the system lock and key, wherein the selective receptor (lock) is selectively anchored to the analyte of interest (or key). This system has great limitations when analyzing the analyte in the presence of other analytes, which can alter the sensitivity or specificity of the measure, as occurs in sensors used in biomedical applications [3] [4]. For these cases, one possible solution is based on the development of sensor arrays, consisting of a combination of different and specific sensors, which may enable simultaneous measurements of one or more analytes in a less favorable environment [5]. These sensors are now a reality, although there is still a long way to go before the levels of precision and accuracy are reached.

Future challenges for the development and commercialization of efficient sensors are mainly focused on improving the specificity, reproducibility, and the ability to detect trace levels. Hopefully in the coming years nanotechnology and nanomaterials allow reaching previously unimaginable advances in the development of these systems.

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