Mini Review

Nanostructured Electrodes For Biosensing: An Innovative Technology With Huge Potential Applications

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Nanomaterials is a recent technology with a wide landscape of potential applications in several fields. In particular, recent researches have demonstrated their appropriateness for biosensing applications in the clinical diagnosis and prevention of several important pathologies. Recent developments in the application of Carbon-based nanomaterials such as carbon nanotubes (CNT) and graphene electrodes have proven their outstanding capabilities of detecting the presence of electroactive compounds in biological fluids, thanks to their excellent electrical conductivity, large surface area and low cost. The structure of graphene is two-dimensional with the carbon atoms forming hexagonal lattices, providing a large surface area for chemical detection. The ability of rapid electron transfer kinetics at the basal planes of graphene sheets act as nanoconnectors and thus electrically facilitates the heterogeneous electron transfer between the biomolecules and electrode substrate, resulting in excellent sensing performance. As one of the most important applications of biosensors, Dopamine (DA) detection in biological fluids is gaining a lot of attention both from researchers and practitioners. In fact, in the last years, dopamine concentration in human body fluids has been related to some neurodegenerative diseases, such as Parkinson and Alzheimer's diseases [1]. The possibility to have a bio-marker for these disease is of extreme importance because, disease related with dementia, are diagnosed when they are already developed and their management become almost impossible. The possibility to continuously monitor DA level in fluids, such as blood and urine, could accelerate the early diagnosis of these diseases.

The principal analytical method to detected dopamine is High Pressure Liquid Chromatrography (HPLC), but this technique does not allow any kind of real time or in situ analysis and, furthermore, is highly expensive and hard to use [2,3]. To achieve a real-time screening of DA, electrochemical sensors are perfect candidates [4]. There is currently a huge potential market for sensing services and devices based on such technology in the area f healthcare services for third-age and personalized assistance. In Europe (EU-28), currently 17% of the population, or 85 million people, are 65 years or older. Projections show that in 2030, 23% or 125 million people, and in 2060, 30% or 155 million people, will be 65 years or older. The ongoing demographic ageing is a real challenge to individuals and families, institutions, healthcare and social care systems. Demographic ageing, therefore, opens up for new initiatives and opportunities for active and healthy ageing, and in such context, Information and Communication Technologies (ICT) can play a decisive role. Modern care, in fact, is based on the paradigm of patient-centric personalized medicine, and on a healthcare path starting with investigations, diagnosis and, if judged necessary, treatment. The production of low-cost devices based on nanostructured biosensors is thus a huge market opportunity, considering the current expansion of the target market, which, for example accounted for $4.08 billion in 2017 for Global Parkinson's Disease Treatment Market, and is expected to reach $7.93 billion by 2026 growing at a CAGR of 7.7%. The exploitation of the outstanding properties of nanomaterials in biosensing devices, this technology can represent a disruptive innovation in the early of several important pathologies, thus increasing the probability of healing and improving the quality of life of millions of patients all over the world [5].

References

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