

Fluorescence-Based Biosensor for Dopamine Detection Using Quantum Dots

Authors : Sylwia Krawiec, Joanna Cabaj, Karol Malecha

Abstract : Nowadays, progress in the field of the analytical methods is of great interest for reliable biological research and medical diagnostics. Classical techniques of chemical analysis, despite many advantages, do not permit to obtain immediate results or automatization of measurements. Chemical sensors have displaced the conventional analytical methods - sensors combine precision, sensitivity, fast response and the possibility of continuous-monitoring. Biosensor is a chemical sensor, which except of converter also possess a biologically active material, which is the basis for the detection of specific chemicals in the sample. Each biosensor device mainly consists of two elements: a sensitive element, where is recognition of receptor-analyte, and a transducer element which receives the signal and converts it into a measurable signal. Through these two elements biosensors can be divided in two categories: due to the recognition element (e.g immunosensor) and due to the transducer (e.g optical sensor). Working of optical sensor is based on measurements of quantitative changes of parameters characterizing light radiation. The most often analyzed parameters include: amplitude (intensity), frequency or polarization. Changes in the optical properties one of the compound which reacts with biological material coated on the sensor is analyzed by a direct method, in an indirect method indicators are used, which changes the optical properties due to the transformation of the testing species. The most commonly used dyes in this method are: small molecules with an aromatic ring, like rhodamine, fluorescent proteins, for example green fluorescent protein (GFP), or nanoparticles such as quantum dots (QDs). Quantum dots have, in comparison with organic dyes, much better photoluminescent properties, better bioavailability and chemical inertness. These are semiconductor nanocrystals size of 2-10 nm. This very limited number of atoms and the 'nano'-size gives QDs these highly fluorescent properties. Rapid and sensitive detection of dopamine is extremely important in modern medicine. Dopamine is very important neurotransmitter, which mainly occurs in the brain and central nervous system of mammals. Dopamine is responsible for the transmission information of moving through the nervous system and plays an important role in processes of learning or memory. Detection of dopamine is significant for diseases associated with the central nervous system such as Parkinson or schizophrenia. In developed optical biosensor for detection of dopamine, are used graphene quantum dots (GQDs). In such sensor dopamine molecules coats the GQD surface - in result occurs quenching of fluorescence due to Resonance Energy Transfer (FRET). Changes in fluorescence correspond to specific concentrations of the neurotransmitter in tested sample, so it is possible to accurately determine the concentration of dopamine in the sample.

Keywords : biosensor, dopamine, fluorescence, quantum dots

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