Nanophotonic Method for Polycyclic Aromatic Hydrocarbons Detection in Water

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Polycyclic aromatic hydrocarbons (PAHs) are the widespread environmental contaminants that can be found in atmosphere, water, soil, sediment and organisms. Among most dangerous PAHs is benzo[a]pyrene (BP). The effects of BP on health are: short-term when people are exposed to it at levels above the maximum contaminant level (MCL) (0.2 ppm) for relatively short periods of time leading to red blood cells damage, anemia ect; suppression of immune system and long-term, when human beings are exposured do BP influence at levels above the MCL namely effects on reproducibility and high probability of cancer illnesses.

There are known methods for PAHs detection, such as chromatography, immuno-chemistry, biological and chemical ones. However, they have several disadvantages, including high cost, duration and complexity of the analysis procedure, the high detection limit and low selectivity. So at present a development of a new method of PAHs detection based on modern technologies and materials such as nanotechologies and nanomaterials. Belonging to above mentioned is nanophotonic method of PAHs assay.

Nanophotonic method for PAHs detection in particular BP in water is a combination of electrochemical and electrochemiluminescence analysis with the application of nanomaterials and nanotechnologies. This method can be carried out using nanophotonic sensor based on nanomaterials such as semiconductor quantum dots (QDs).

Nanophotonic method is based on process of QDs transfer to ionic forms in a consequence of electrochemical processes and reactions with oppositely forms of the analyte – PAHs (BP), resulting in the emission of an analytical optical signal. The number of quanta emitted at the given period of time is a measure of PAHs (BP) content thus characterizing the essence of nanophotonic assay method for PAHs (BP) detection in water. Increase the selectivity by the proposed method is being due to the following reasons: chemical approach which consists in dividing the particles in assay probe using the electrophoresis method; mechanical approach, which includes filtration with the use of high-quality systems for segregation of the sample components by size; physical approach based on the selection of specific QDs under molecule-analyte by finding the optimal physical parameters of QDs, and electrochemical approach based on using voltammetry in the assay procedure. The above-mentioned approaches are discussed in a presented paper.

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