

ELECTROCHEMILUMINESCENT METHOD FOR POLYACENES DETECTION USING SEMICONDUCTOR QUANTUM DOTS

Sushko O.A.*

*Laboratory of Analytical Optochemotronics named after M.M. Rozhitskii,
Kharkiv National University of Radio Electronics: Nauky ave., 14, Kharkiv, 61166, Ukraine;
olha.sushko@mure.ua*

Polyacenes or 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 exposed do BP influence at levels above the MCL namely effects on reproducibility and high probability of cancer illnesses [1].

There are known methods for PAHs detection, such as chromatography, immuno-chemistry, biological and chemical ones [2]. However, they have several disadvantages, including high cost, duration and complexity of the analysis procedure, the high detection limit and low selectivity. Therefore, a well-proven electrochemiluminescence method of PAH reduction was used in combination with modern technologies and materials, such as nanotechnology and nanomaterials.

The proposed 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) [3].

Electrochemiluminescence method in combination with semiconductor quantum dots 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 electrochemiluminescence 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 [4].

Main advantages of the developed electrochemiluminescence method and nanophotonic sensor for polyacenes detection are low limit of detection (down to $1 \cdot 10^{-9}$ mole/l); rather fast and simple sample preparation and assay procedures; low assay cost; portability, energy efficiency and fully automatization of an assay; possibility of recycling of sensor's materials.

It is competitive with known analytical technologies for bioliquids assay such as fluorescent, electrochemical etc.

1. M. M. Rozhitskii, O. A. Sushko Research and Development Database TechProfiles.org, (electronic resource), (2015).

2. O. A. Sushko, O. M. Bilash, M. M. Rozhitskii, Luminescence. Vol. 27, No. 1. 101 (2012).

3. O. A. Sushko, O. M. Bilash, M. M. Rozhitskii Electrochemistry for advanced materials technologies and instrumentation : The 63rd annual meeting of the ISE. Prague, Czech Republic, S12-031 (201).

4. O. A. Sushko, M. M. Rozhitskii, Journal of Nano- and Electronic Physics. Vol. 6, No. 1. 01009 (2014).