Electrochemical Sensor based on Prussian Blue for Hydrogen Peroxide Detection in Exhaled Breath

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Today, the high incidence rate of fatal accidents and occupational diseases in industries is alarming. The use of safety devices and periodic health checks for workers certainly reduce the associated risks, but they are unable to monitor their condition in real-time. In recent years, the research aims to develop electrochemical sensors as an alternative to time-consuming and expensive traditional diagnostic techniques. Electrochemical sensors are generally flexible and they can be miniaturized; these properties allow their integration into wearable devices. [1]

In this work, a low-cost electrochemical sensor was developed to be inserted into a mask for the detection of hydrogen peroxide in the exhaled breath in real-time [2]. Hydrogen peroxide is the most used biomarker in monitoring oxidative stress due to its stability and ability to diffuse across the cell membrane. Oxidative stress occurs when the concentration of hydrogen peroxide in biological fluids increases. Since it is not associated with specific symptoms, it is important to monitor the concentration of hydrogen peroxide to prevent the onset of serious diseases or slow down their progression. [3]

The low cost of this device is related to the fact that it is obtained from CDs at the end of life because their metallic layer, a thin film of silver, can be used for its electrochemical properties. The silver layer was peeled off the CD and a three electrodes configuration was given using a laser cutter. Then, a graphite and an Ag/AgCl pastes were applied to the counter and the reference electrode respectively [4], while the working electrode was modified with Prussian Blue to improve the electrochemical performance.

Prussian Blue is the most advantageous hydrogen peroxide transducer due to its activity for hydrogen peroxide reduction at low potentials. So, it is also selective because at these potentials many common interfering substances do not show electrochemical reactions.

These properties stem from the crystal structure of Prussian Blue. The crystal contains small channels that permit the entry of hydrogen peroxide. Surrounded by iron ions, electron transfer to the hydrogen peroxide is facilitated. For most interfering species, the channels are too narrow to allow passage. [5]

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