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Determination of Chemical Oxygen Demand (COD) Using Nanoparticle-Modified Voltammetric Sensors and Electronic Tongue Principles †

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Chemical Oxygen Demand (COD) is a widely used parameter in analyzing and controlling the degree of pollution in water. COD is defined as the amount of molecular oxygen (in milligrams of O_2) required to decompose all the organic compounds in 1 L of aqueous solution to carbon dioxide and water. Electro-oxidizing the organic contaminants to completely transform them into CO_2 and H_2O using sensors is considered the best method for COD estimation. In this sense, copper electrodes have been reported based on the fact that copper in alkaline media acts as a powerful electrocatalyst for oxidation of aminoacids and carbohydrates, which are believed to be the major culprits for organic pollutions.

In this work, four electrodes were studied for COD analysis employing the cyclic voltammetry technique: Nafion film covered electrodeposited CuO/Cu nanoparticle electrode (**E1**), Cu nanoparticle-graphite-epoxy composite electrode (**E2**), CuO nanoparticle-graphite-epoxy composite electrode (**E3**) and Ni Cu alloy nanoparticle-graphite-epoxy composite electrode (**E4**). Glucose, glycine, potassium hydrogen phthalate (KHP) and ethylene glycol, which show different reducibilities, were chosen to be the standard substances to play the role of organic contaminants with different degradation difficulties. It was observed from the obtained cyclic voltammograms that glucose is very easy to be oxidized by those four electrodes and electrode **E1** shows the best performance, with a linear range of 19.2~1120.8 mg/L and limit of detection of 27.5 mg/L. Besides, KHP is very difficult to be oxidized by these four electrodes. Water samples were also analyzed with the electronic tongue array composed of these four electrodes based on the Principle Component Analysis (PCA) technique. As a result, the main component of river samples, which is easy or difficult to be degraded, can be evaluated by the PCA technique. This evaluation is very helpful for the accuracy of COD detection. The resulting sensor-based method demonstrates great potential not only for estimating the precise value of COD, but for predicting the difficulty behavior in its degradation, in a simple, fast, and clean methodology, which is completely suited to the present demands of green techniques.

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