POLYANILINE NANOCOMPOSITES AS POTENTIAL PHOTOELECTROCATALYSTS FOR CARBOYHYRATE OXIDATION

Sinéad. T. Farrell, Carmel. B. Breslin

Department of Chemistry,
National University of Ireland Maynooth,
Maynooth, Co. Kildare,
Ireland.

Numerous applications have been found for the diverse properties of organic conducting polymers since their discovery over twenty years ago. One such area is the use of conducting polymers in electrocatalysis [1,2]. As the polymers are porous in structure, they are an ideal supporting matrix for noble metal particles. The resulting composite electrodes have large effective surface area and uniform dispersion of metal catalyst. Also the high conductivity of the polymer allows the easy transport of electrons to the isolated catalytic sites [3].

In this work the electrocatalytic and photoelectrocatalytic activity of polyaniline films modified by noble metals towards the oxidation of various carbohydrates are examined. Polyaniline films were grown on a platinum substrate (0.126 cm^2) from a 0.1 M Aniline/1.0 M H_2SO_4 solution by continuous potential cycling between –0.2 V to 0.75 V vs Ag|AgCl. Under these conditions polymers were grown reproducibly to a thickness of 0.15 µm. Copper particles were incorporated into the polyaniline film from a 0.02 M $CuSO_4$/0.1 M H_2SO_4 solution by an under potential deposition process. The applied potential and application time were varied systematically to achieve maximum distribution of the particles.

The activity of the composite electrode to the oxidation of 3 mM glucose in 0.15 M NaOH was monitored through cyclic voltammetry. The experiments showed an irreversible oxidation current peak circa +0.55 vs Ag|AgCl. The procedure repeated with the electrode surface exposed to intense UV illumination showed a dramatic 300% increase in the forward oxidation current, direct evidence of a photoelectrocatalytic process (Figure 1). A similar increase was found for the electrooxidation of glucose at a pure copper substrate with UV illumination. Typically, 32.7 mC cm^{-2} is passed in one complete oxidative cycle with illumination for pure copper compared with 41.8 mC cm^{-2} for the composite electrode. This result shows that the composite is a more efficient photocatalyst than the pure copper for the electrooxidation of glucose.

Using this method the electrocatalytic activity of the copper modified electrode and the pure copper electrode towards the oxidation of fructose, sorbitol and glycine was examined. Also to contrast the influence of copper in the electrocatalytic/photoelectrocatalytic process a gold modified polyaniline and pure gold electrode were also examined as electrocatalytic materials toward the oxidation of these carbohydrates.

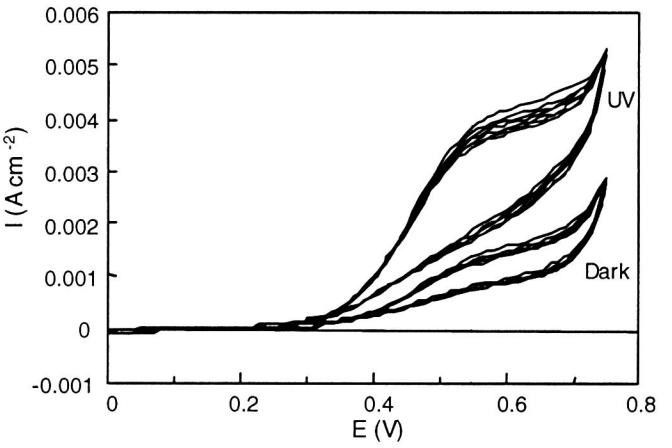

Figure 1. Cyclic voltammogram of the oxidation of 3 mM Glucose in 0.15 M NaOH at polyaniline-copper electrode under dark and UV illumination conditions. Sweep Rate = 50 mV s^{-1}

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