Fabrication of a glucose biosensor on porous anodic alumina substrate using reflectance and photoluminescence techniques

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Introduction

The porous anodic alumina (PAA) can present responses to reflectance and to photoluminescence techniques characterized by the phenomenon of waveguides or Fabry-Pérot effect. This phenomenon can be used in optical sensor as responses when the PAA is used as a substrate in the manufacture of self-assembled films by layer-by-layer technique (LBL). Thus, following the deposition of polyelectrolytes as hydrochloride polyallylamine (PAH), polyvinyl sulfonic acid (PVS) and the enzyme glucose oxidase (GOx) on PAA film, it is possible to study the growth of LBL films in order to fabricate an optical glucose biosensor [1, 2].

In this work, the growth of films of PAH/PVS/PAH/GOx on PAA substrate and their photoluminescence and reflectance responses were investigated.

Results e Discution

PAA samples were fabricated by two-step potentiostatic anodisation of electropolished aluminum in 0.3 mol/L oxalic acid at 15°C and an applied voltage of 40V. The first step of anodisation was carried out for 2h and it was followed by chemical etching in a mixture of 0.4 mol/L phosphoric acid and 0.2 mol/L chromic oxide at 60°C for 1h. Then, the second step of anodisation was performed for 30 minutes and the sample was subjected to a pore widening process for 30 min in 0.3 mol/L oxalic acid at 15°C. These samples were used as substrates in LBL technique for the growth of assembled layers of PAH/PVS/PAH/GOx for manufacturing an optical glucose biosensor. The film growth was accompanied by luminescence and reflectance in order to compare both techniques. The solutions of 0.004 mg/mL PAH, 0.08 µL/mL PVS and 0.002 mg/mL GOx were prepared in sodium phosphate buffer solution at pH 6.3.

Figure 1 depicts the photoluminescence and reflectance responses of the biosensor in contact with glucose. The results showed that the deposition of polyelectrolytes promoted an increase of intensity in photoluminescence, inset of Figure 1(A), indicating the presence of more compounds absorbing and emitting from substrate. A decrease in reflectance signal is observed in inset of Figure 1 (B), due to increased absorption of radiation by polyelectrolytes.

In the sensor essay, the sample of PAA with deposited film was placed in contact with a glucose solution 0.001 g/mol prepared in sodium phosphate buffer solution at pH 6.3. Subsequently, the photoluminescence, Figure 1 (A), and reflectance measurements, Figure 1 (B), were performed. Note that photoluminescence technique to the sensor response is sharper than reflectance technique, since there is a more visible change in frequency of the Fabry-Pérot oscillations. This behavior was expected due to the greater sensitivity of photoluminescence technique [3].

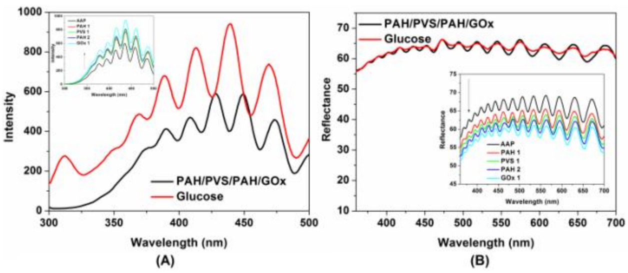

Figure 1. Photoluminescence (A) and reflectance (B) spectra of PAH/PVS/PAH/GOx/PAA film in contact with glucose. Excitation for PL was 280 nm.

Conclusions

It was verified the possibility of deposition of a layer of PAH/PVS/PAH/GOx with LBL technique on PAA substrate. Furthermore, it was found that the luminescence was more sensitive technique for analysis the phenomenon of waveguides, because the Fabry-Pérot oscillations were more intense in photoluminescence measurements than in reflectance. It was also found that the change in the frequency of these oscillations occurred only with the photoluminescence technique.

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