INTRODUCTION

The present study reports on the application of cold plasma technologies as a very simple and effective technique for the preparation of glucose electrochemical sensors. More specifically, in this work we show that the treatment of polymeric surfaces in a room-temperature air-discharge plasma, which is a simple and powerful means of surface modification, enables the fabrication of glucose sensors using not only electrochemically active CPs, as for example poly(3,4-ethylenedioxythiophene) (PEDOT), but also conventional insulating and electrochemical inert polymers, as low density polyethylene (LDPE). Accordingly, these plasma treated polymer-coated electrodes have the potential to be used and developed into truly selective and sensitive glucose sensors, independently of the nature of the polymer, which is very attractive in terms of fabricating efficient but also cost-effective sensors.

Glucose detection electrochemical response

Regular monitoring of glucose levels in the human body is crucial for the diagnosis and management of diabetes, which has become a worldwide public health problem. In addition, monitoring of the glucose metabolism through the detection of changes in the concentration of this important chemical may improve the treatment of brain diseases (e.g. brain tumors and traumatic brain injuries).

Enzymatic immobilization onto surfaces is the most important stage that takes place in biosensors fabrication processes. Various types of interactions may influence the detection of glucose, which depend both on the enzyme and the surface of the sample. Surface properties like wettability, linked to topography, roughness, and chemistry, have been shown to alter enzyme adsorption and immobilization.

XPS SURFACE CHARACTERIZATION: study of plasma surface functionalization

Our interest remains in the morphological change and functional groups induced in the surface of sensors for electrochemical detection and enzyme immobilization. Different species of nitrogen, oxygen and carbon have been detected on the surface of cold plasma treated polymeric-modified carbon based electrodes.

Conclusions and outcome

The overall of these results clearly indicate that electrochemically inert polymers can be successfully transformed into electrochemical sensors for detection by applying a simple cold plasma treatment. The implications of this approach are very significant. The replacement of CPs and inorganic catalytic nanoparticles by conventional commodity polymers provokes a significant reduction in the economic cost of the detection devices. Also, the substitution of nanocomposites processing and/or multi-step synthetic processes by a simple cold-plasma treatment results in a significant diminution of the cost. Furthermore, this strategy is friendly from an environmental point of view since it opens a new door for the technological reuse of recycled polymers.

On the other hand, XPS results clearly indicate that the nature of reactive species formed upon exposure of the polymer-modified electrode to the cold plasma depends on the chemical structure of the polymer and, in some cases, on the duration of the treatment. Considering that such reactive species catalyse the transformation of glucose to its oxidized form glucono-δ-lactone, differences in the response of the different plasma-treated polymers should be attributed to the diversity of reactive species at the treated-electrode surface.