Charging and capacitance properties of fluorine doped tin oxide aimed for the interfacial part of miniaturized biochemical sensors

Raphael A. S. Nascimento and Marcelo Mulato
Department of Physics, FFCLRP - USP, Ribeirão Preto, SP, Brazil

Many biochemical sensors are developed using the interaction of a solid state material with the interest solution. The substances to be detected many times are intrinsically charged or lead to charge variation on top of the surface. Among these sensors the field effect devices are commonly used. As sensing film, FTO (fluorine doped tin oxide) is a strong candidate. In this study we present a detailed investigation about the charging and capacitance properties of the material, together with its final use as sensing part of an EGFET. Impedance spectroscopy was used as a tool and the measurements were performed under varied pH buffer solutions as presented in figure 1.

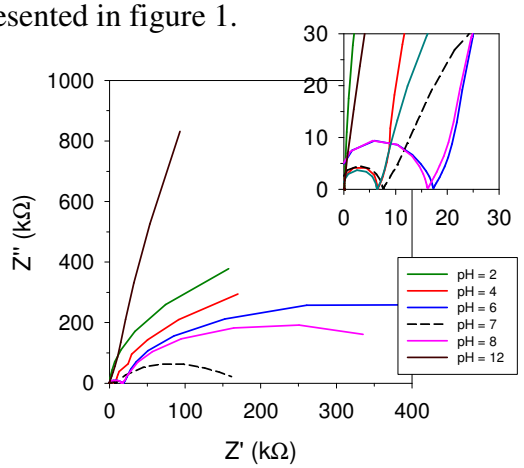

Figure 1 – Impedance spectroscopy under varied pH solutions. Equivalent circuit analysis lead to the investigation of the properties of the material.

After the determination of the equivalent circuit and the basic properties of the material, cyclic voltametry was also performed. Asymmetric behavior for positive and negative polarization was observed as presented in Figure 2. The charging and de-charging effect were investigated for varied biases. Charge trapping and diffusion will be discussed for the better understanding of the main mechanisms responsible for the behavior of the EGFET sensor when using FTO.

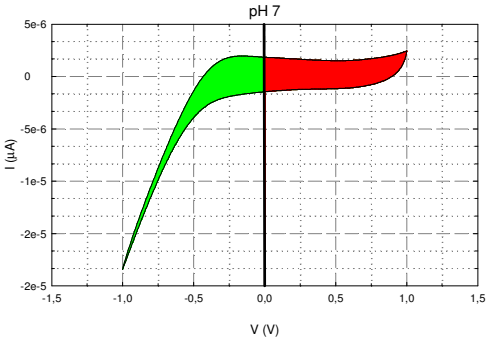

Figure 2 – Cyclic voltametry was performed for pHs 2 to 12.

The sensitivity of the constructed sensors is about 51 mV/pH as presented by the liear data in Figure 3 for the pH range from 2 to 12.

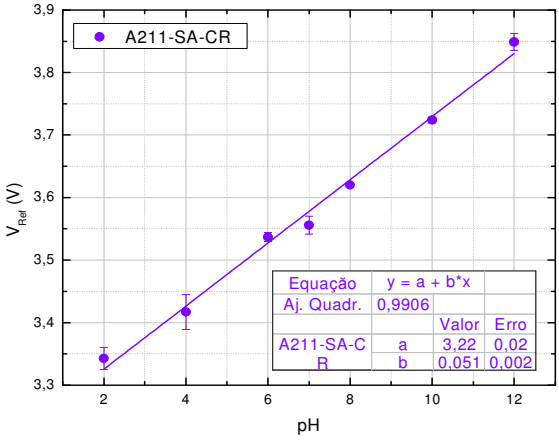

Figure 3 – Linear response of the EGFET with sensitivity of 51 mV/pH.

In summary the capacitance and charging and diffusion effects will be discussed. The importance and consequences for further use of the device as biochemical sensor (urea, glucose, etc) will also be discussed. Work supported by Capes, CNPq and FAPESP.