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MIS capacitor using polyaniline as semiconductor

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Abstract: Metal-insulator-semiconductor (MIS) capacitor was prepared using polyaniline (PAni) and aluminum oxide (AlO_2). The oxide film was grown by electro-deposition and the PAni film was deposited by *in situ* polymerization method. Morphological characterization of aluminum oxide and PANI films showed good uniformity and homogeneity. The electric conductivity of the PAni film was determined fitting capacitance and loss curves versus frequency experimental curves using the MIS equivalent circuit. Conductivity of 1.7 $x10^{-4}$ Sm^{-1} was found for PAni doped samples which decreases when the PAni sample was dedoped at room conditions.

The polyaniline (PAni) is a versatile polymer since it can be obtained from a non-conductive to highly conductive state by chemical doping. It is largely used because of its good environmental stability, can be easily synthesized and it shows a reversible doping/dedoping process. Up to now there are few reports on literature [1,2] concerning its use to fabricate metal-insulator-semiconductor capacitor (MIS) and field effect transistors (OFETs) [3] devices. We prepared MIS capacitors using PAni as semiconductor polymer and aluminum oxide as insulator. The aluminum oxide film with thickness of ~60 nm was electrochemically grown from a thick aluminum layer which was previously evaporated in vacuum onto a glass slide. The PAni film with thickness of ~100 nm was obtained on the top of the aluminum oxide by *in situ* deposition method. To complete the MIS device a circular gold layer was evaporated onto the PAni film to form the ohmic contact. Atomic force microscopy (AFM) images of Al oxide films display a good uniformity and homogeneity while the PAni film surfaces present a roughness as previously described in literature. Measurements of capacitance and loss curves on frequency were performed using a Solartron analyzer at room conditions. The capacitance curves on frequency show a typical response of a MIS capacitor while the loss curves show the Maxwell-Wagner relaxation peak at $5x10^5$ Hz, characteristic of the MIS capacitor[4,5]. The electric conductivity of 1.7 $x10^{-4}$ Sm^{-1} was obtained by fitting the capacitance and loss curves using the equivalent circuit model. Measurements performed in the MIS capacitor exposed to room atmosphere during one week show a displacement of the Maxwell-Wagner the peak frequency compatible with the PAni dedoping process. Values of conductivity are in good agreement with literature data and our results also indicated the feasibility of the use of MIS to characterize films the PAni under different doping conditions. The next step of the work is to fabricate PAni OFETs structures that can be used in several application as sensor like ammonia gas sensor.

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