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Electrochemical applications of Diamond-Like Carbon (DLC) films deposited by reactive magnetron sputtering

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Abstract – In this work were presented the study of the electrochemical properties of Diamond-like Carbon (DLC) films. The films were deposited by reactive magnetron sputtering using a pure graphite target and argon, methane as processing gas. The sputtering process possibility the doping of DLC thin films, for this we use H_2, SF_6, N_2 as doping agent. This gas sources promotes the incorporation of hydrogen, fluorine and sulfur in these films. It is result in a new application of DLC films as electrochemical electrode and proton ionic permeable membranes. These materials have application in a energy generation, super-capacitor, hydrogen fuel-cells, electrochemical cells and dye solar cells.

Diamond-like Carbon (DLC) films were studied and used in a lot of application in the last decades [1]. In the past years news applications of these films were developed. These new applications of DLC thin films include electrical and optical applications, electrochemical applications and nanotechnology [2]. In special the electrochemical application have a main studies in energy generation and conservation. In these cases the DLC thin films were employed in semi permeable membranes [3], electrodes, super capacitors, electrode for dye-cells and proton ionic membranes for fuel cells [4]. In this work we shows the recent study about the ionic permeable membranes for electrochemical cells. For this we deposit the DLC thin films by magnetron reactive sputtering using a graphite target, methane and argon as process gas. The doping of these films were obtained by gaseous sources (H_2, SF_6, N_2) added to the gaseous ambient.

The main goal of this work is to study the deposition process influence on the electrical and electrochemical properties of DLC films, was used silicon wafers and cooper slices as substrate, the DLC films were deposited in a methane and argon atmosphere in a RF Magnetron Sputtering system using graphite 99.9999% pure target. The samples were deposited in two working pressures (5 m Torr and 10 m Torr), and in each pressure condition, the RF power was adjusted to 100W, 150W, 200W. For electrical measurements, aluminum contacts were deposited on the DLC film side and at the Si side, by thermal evaporation. The dielectric constant was calculated through the maximum capacitance, obtained by high frequency CxV analysis in a HP 4248 system. In IxV analyses, with a HP 4140A picoamperemeter. some samples showed semiconductor characteristics .The electrochemical application was analyzed by cyclic voltametry, impedance measure and chemical corrosion. This results shows application in electrochemical cells and fuel cells or selective electrodes.

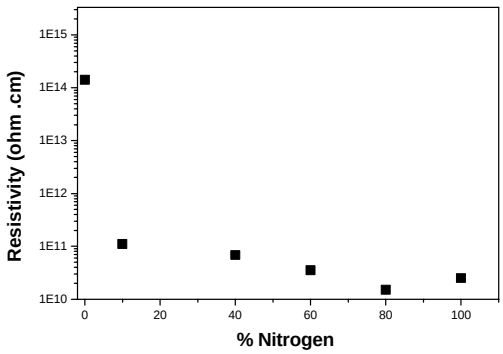

Figure 1: Resistivity of nitrogen doped DLC thin films.

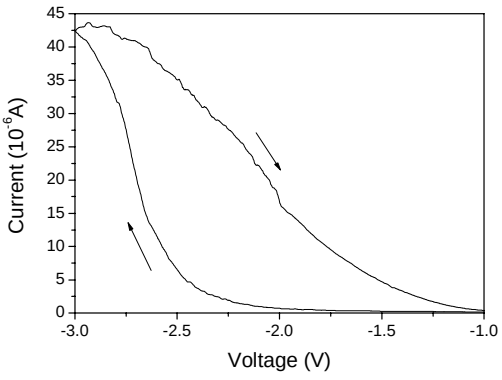

Figure 2: Voltrametric analyse of Proton-ionic DLC membrane

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