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Effect of Substrate Bias in Copper Sputtering Plasma Measured by Langmuir Probe

Abstract

There are several techniques to deposit the metal oxide thin film such as electron beam evaporator, pulse laser deposition and reactive magnetron sputtering deposition. In this experiment, magnetron sputtering deposition techniques will be used to produce a copper oxide thin film due to its simplicity and repeatability performance. Recently, copper oxide thin film has been studied because of its low cost material, sensitivity to ambient condition and easiness to produce oxide thin film. It is one of the p-type semiconductor oxides materials that are suitable to be used as a gas sensing material. In order to increase the sensitivity and to optimize the properties of copper oxide thin film, it is essential to study on the plasma properties during the deposition of copper oxide. In current studies, Langmuir probe was used to investigate the effect of substrate bias towards the fabrication of copper oxide thin film at rf dissipation power of 400 W. The oxygen flow rate was fixed at 8sccm. The Langmuir probe tip was focus at roughly 2 cm above the substrate holder. The ion and electron current were collected from the plasma environment. Then the electron temperature, electron density, ion density, ion flux, Debye length and plasma potential at various substrate biases were evaluated from the current-voltage curve. The electron temperature at various oxygen flow rates was almost unchanged. The effect of substrate bias toward the electron temperature was also almost unseen, except that the electron temperature at-40 V bias voltage was slightly lower than others. In addition, the ion flux at the same plasma condition shows that the ion flux was higher at-40 V substrate bias voltage. The results suggest that the ion bombardment effect toward the deposited copper oxide thin film would be higher at low oxygen flow rate. Thus it will create a rough surface morphology or nanostructured copper oxide thin film. This is a potential ways to improve the sensitivity of copper oxide gas sensor.

Keywords; Copper Oxide, Langmuir Probe, Reactive Magnetron Sputtering