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Electron and ion densities measurement in reactive magnetron zinc sputtering plasma

Abstract

Investigation on the plasma properties is an essential fundamental works in order to precisely control the growth of nanoscale thin film. In the present work, we produced and study the reactive magnetron sputtering plasma in Ar+O_2 ambient using a solid Zn target as sputter source. We evaluate the electron temperature, electron density and ion density using Langmuir probe measurement as a function of O_2 flow rate and working pressure. We found that the electron temperature increased spontaneously with the oxygen flow rate. The electron temperature was almost doubled when O_2 flow rate increased from 0 sccm to 10 sccm. The electron and ion densities increased with the oxygen flow rate between 0 sccm and 5 sccm. However, after 5 sccm of O_2 flow rate which is approximately 11% of O_2/(O_2+Ar) flow rate ratio the electron density decreased drastically. This is due to the electron attachment and the production of negative ion species in Ar+O_2 plasma environment. In addition, we found that the ion flux increase monotonically with the O_2 flow rate thus will increase the ion bombardment effect on the deposited thin film and eventually damage the thin film. Our experimental results suggest that the O_2 flow rate and the working pressure would have a significant influence on ion bombardment effect on deposited thin film.

Keywords; Langmuir Probe Measurement, Zinc Magnetron Sputtering Plasma, ZnO Thin Film