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Properties of transparent IGZO thin films prepared using conventional sputtering methods and HiPIMS

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We report on the properties of transparent semiconducting amorphous indium gallium zinc oxide (IGZO) thin films prepared by conventional sputtering methods and those prepared by high power impulse magnetron sputtering (HiPIMS). Transparent semiconducting amorphous IGZO films have attracted great attention due to their excellent electrical properties and possible utilization in thin film transistors or in photovoltaic applications. It is known that the properties of IGZO films are highly sensitive to process parameters, especially to oxygen partial pressure. In this study we have focused on the comparison of various methods of magnetron sputtering in order to optimize electrical and optical properties of the IGZO thin films and to investigate possibility to apply these coatings on thermally sensitive flexible substrates. We employed dc, pulsed dc, mid frequency sine wave and HiPIMS power supplies for magnetron deposition. Magnetrons were equipped with ceramic InGaZnO targets. In all experiments we focused on the effect of oxygen partial pressure, discharge power and pulsed power mode on the electrical, optical and mechanical properties of IGZO thin films and also on the thermal load deposited to the substrate. We have observed a very fast transition between low- and high- resistivity films depending on oxygen partial pressure. It is shown that the electrical resistivity can be effectively controlled in the wide range of values from 10^{-2} to 10^{11} Ω.cm. The highest mobility of charge carriers (up to 50 $cm^2/V.s$) was obtained at very low oxygen partial pressures. Deposition rate as a function of discharge power and oxygen partial pressure was also systematically investigated and the results from optical, electrical and structure analysis will be discussed in detail.

Keywords
Magnetron sputtering
HiPIMS
Semiconducting films
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