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Tunable optical and electrical properties of IGZO thin films prepared by reactive HiPIMS

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We report on the tunable optical and electrical properties of transparent semiconducting amorphous indium gallium zinc oxide (IGZO) thin films 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 order to reach tunable properties of transparent IGZO films we have employed HiPIMS which is very suitable and progressive method for preparing high-quality oxide layer. This is mainly due to a high degree of ionization of target material particles in the discharge plasma and associated high ion-to-atom ratio in particles flux toward the substrate. These features lead to formation of very dense films structure. Moreover, enhanced kinetic energy of particles impacted onto growing film deliver significant amount of energy promoting the growth of the films and is very important especially in the case of deposition on heat sensitive substrates. In this paper we show the use of reactive HiPIMS is an effective way to produce IGZO films, and that the value of pulse-averaged target power density being in the range of 100-1020 Wcm^{-2} (which is two orders of magnitude higher compare with the conventional dc or RF magnetron sputtering) and the repetition frequency are suitable parameters for controlling the optical and electrical properties of the IGZO films. Correlation between plasma discharge parameters and electrical and optical properties of deposited films will be discussed and explained in details.

Keywords
HiPIMS
IGZO
tunable properties
reactive sputtering