Study of Iridium Ions Influence on Optical Properties of Zinc-Iridium Oxide Thin Films

V. Skvortsova, M. Zubkins, R. Kalendarevs, G. Chikvaidze, J. Purans

Institute of Solid State Physics, University of Latvia, Latvia

e-mail: vera@cfi.lu.lv

Acquisition of the transparent p-type conductive oxides (TCOs) is one of the important tasks in material science. TCOs thin films with good optical transparency, high p-type conductivity, high work function, and low deposition temperature could be used as p-type electrodes in thin-film photovoltaic devices, flat panel displays, light emitting devices and transparent electronics [1, 2]. Unfortunately, there is no p-type TCOs meeting all these requirements at the moment. Dekkers [3] in 2007 reported that polycrystalline $ZnIr_2O_4$ thin films are transparent p-type semiconductors. This paper presents results of the absorption spectra investigation of zinc-iridium oxide thin films. Zinc-iridium oxide thin films were deposited by reactive DC magnetron sputtering on various substrates. Iridium concentration was controlled by iridium amount on the zinc target erosion zone and oxygen to argon ratio.

Zinc-iridium oxide thin films are transparent in the visible region. Iridium concentration increase leads to film transparency decrease. The absorption spectra in the visible range contain three broad bands with maxima: 240, 446 and 710 nm. In the near infrared and infrared regions the absorption spectra of zinc-iridium oxide thin films with different iridium ions concentration exhibit two broad bands with maxima at about 1100 nm and 3330 nm. With the iridium concentration increase in the zinc-iridium oxide thin films the intensity of the 1100 nm band increases, reaching a maximum at iridium concentration of 29 %. The further iridium concentration increase up to 41% leads to an increase in intensity of the band of 3330 nm. At the iridium concentration from 47 to 56 % the ratio of the intensities of the 1100 and 3330 nm bands does not change. It is shown that the observed absorption bands are associated with iridium ions with different valence states. At the low iridium concentrations the obtained zinc-iridium oxide thin films have normal spinel structure. Iridium concentration increase leads to the formation of the inverse spinel structure.

Participation is supported by ERAF project No. 2015/0014/2DP/2.1.1.2.0/14/APIA/VIAA/010

References

1. J.F. Wager, D.A. Keszler, and R.E. Presley: Transparent Electronics, Springer, New York (2008)
2. A. Zakutayev, J.D. Perkins, P.A. Parilla, at al., MRS Communications **1**, 23 (2011)
3. M. Dekkers, G. Rijnders, and D. H. A. Blank, Appl. Phys. Lett. **90**, 021903 (2007)