Improvement of microstructural, electrical, and optical characteristics of ZnO:Ga grown by oxygen radical-assisted pulsed-laser deposition

Min-Suk Oh, Dae-Kue Hwang, Jae-Hong Lim, Young-Seok Choi, Ja-Yeon Kim, Tae-Young Park and Seong-Ju Park*

Department of Materials Science and Engineering & National Research Laboratory for Nanophotonic Semiconductors, Gwangju Institute of Science and Technology

* E-mail : sjpark@gist.ac.kr

Recently, transparent conductive oxide (TCO) thin films are attracting great attention and broadly used in many fields such as flat-panel displays, solar cells, and optoelectronic devices.

Highly transparent and conductive Ga-doped ZnO thin films (~400 nm thick) were deposited at low temperature of 100℃ by oxygen radical-assisted pulsed-laser deposition (RA-PLD). The structural, electrical, and optical properties of the films have been investigated as a function of rf power levels. X-ray reflectometry showed that the density of the films grown by RA-PLD increased up to 5.3 g/cm^3. An average optical transmittance of 97.2 % in the long-visible wavelength range (500~600 nm) and resistivity as low as 3.5×10^{-4} Ω·cm were achieved from films deposited at an rf power of 100 W. In addition, plasma edges of the samples were shifted toward longer wavelength region as the rf power increased, which means strong free carrier absorption at near-IR region was decreased with introduction of oxygen radicals, establishing the improvement of near-IR transparency. The results suggested that assistance of radical oxygen atoms with moderately controlled rf power during PLD growth is very promising to deposit high quality transparent conducting ZnO films, which is a good candidate for long-visible wavelength optoelectronic and solar cell device applications.