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Growth of zinc oxide thin films by oxygen plasma-assisted pulsed laser deposition

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Zinc oxide (ZnO) is a functional material with interesting optical and electrical properties, a wide band gap (more than 3.3 eV), a high transmittance in the visible light region, piezoelectric properties, and a high n-type conductivity. This material has been investigated for use in many applications, such as transparent electrodes, blue light-emitting diodes, and ultra-violet detector. ZnO films grown under low oxygen pressure by thin film deposition methods show low resistivity and large free electron concentration. Therefore, reducing the background carrier concentration in ZnO films is one of the major challenges ahead of realizing high-performance ZnO-based optoelectronic devices.

In this study, we deposited ZnO thin films on sapphire substrates by pulsed laser deposition (PLD) with employing an oxygen plasma source to decrease the background free-electron concentration and enhance the crystalline quality. Then, the substrate temperature was varied between 200 'C to 900 'C The vacuum chamber was initially evacuated to a pressure of 10^{-6} Torr, and then a pure O_2 gas was introduced into the chamber and the pressure during deposition was maintained at 10^{-2} Torr. Crystallinity and orientation of ZnO films were investigated by X-ray diffraction (XRD). The film surface was analyzed with atomic force microscope (AFM). And electrical properties were measured at room temperature by Hall measurement.