

Influence of heat treatments on electrical properties of ZnO films grown by molecular-beam epitaxy

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Abstract : We report on the influence of heat treatments on the electrical properties of ZnO films grown by molecular-beam epitaxy. We note that the electrical resistance of the ZnO films is significantly changed by the heat treatments: the electrical resistance increases with the increase of ambient temperature, but above a critical temperature the resistance decreases with the increase of temperature, irrespective of ambient gases. On the other hand, it is found that the large amount of photocurrent is generated in the ZnO films, exposed to white sources: the photocurrent decreases with the increase of the obtained resistance, and the current increases with the decrease of the resistance. Also, it is shown that the X-ray diffraction linewidth of the ZnO films is significantly decreased by the heat treatments. These indicate that the increase/decrease of the electrical resistance is ascribed to the annihilation/formation of the residual donor-type defects in the ZnO films by the heat treatments. It is suggested that the increase of the electrical resistance is due to the annihilation of Zn-complex defects, while the decrease of the electrical resistance is due to the formation of VO-complex defects.

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