The effect of annealing on Raman scattering of Sb-doped ZnO epitaxial layers grown on *a*-Al_2O_3

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Zinc oxide is a natural n-type semiconductor with potential applications in optoelectronic devices dedicated for UV-blue range. Its p-type conductivity may be induced by introducing group I or group V elements into material's crystal structure, but obtaining it still remains a challenge, therefore the literature is lacking the reports about the properties of high-quality p-ZnO. Proper annealing conditions appear to play a role in p-ZnO manufacturing process. We present the results of studies on the influence of annealing on photoluminescence (PL) and micro-Raman spectra of MBE ZnO layers successfully doped with Sb and grown on Al_2O_3 substrates. The photoluminescence spectra recorded at 6 K are dominated by two peaks: at around 3.31 eV and 3.35 eV. First one is assigned to free electrons to neutral acceptors (FA). The second peak corresponds to donor bound exciton (D^0X). In order to properly identify and analyze Raman modes, measured room temperature Stokes Raman spectra were compared with spectra of similar ZnO:As/Al2O3 structures. Besides regular ZnO and Al_2O_3 modes, recorded Raman spectra contain 3 additional modes at around 509, 532 and 575 cm^{-1}, that are associated with doping. The intensity of doping-related bands decreases with increasing annealing temperature, which indicates the improvement of crystal quality of the structure. Spectra also indicate the presence of compressive in-plane strain that decreases in value with increasing annealing temperature and is attributed to thermal residual stress, resulting from differences in thermal expansion coefficients of ZnO and Al_2O_3.

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