Nanostructure surface

Impact of rapid thermal annealing on optical properties of Mn^+-ion implanted of ZnO nanorods

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Doping ZnO transition metal atoms can get diluted magnetic semiconductors, which in the future may be used in spintronic devices. In this work investigated the influence of different doses of Mn^+-ion implantation ($0{,}5\cdot10^{14}$; $2\cdot10^{14}$ and $3\cdot10^{14}$) and rapid thermal annealing (RTA) at 700^0C for 2 min on optical properties of ZnO nanorodes (NRs). The low temperature aqueous chemical growth method was used for the synthesis of ZnO NRs with diameter 450-600 nm on glass substrates. Micro-Raman spectra of pure ZnO NRs exhibits vibration modes peaked at 98.3, 332.0, 378.0, 437.2, 410.0 and 579.7 cm^{-1} which corresponding E_2^{low}, E_2^{high}-E_2^{low}, A_1^{TO}, E_1^{TO}, E_2^{high} and A_1^{LO} modes that characterize wurtzite structure of ZnO NRs. Implantation of Mn^+ ions ZnO NRs leads to the formation of a solid solution $Zn_{1-x}Mn_xO$ and registration in micro-Raman spectra additional mode at 552 cm^{-1} which attributed to Zn-related vibration due to Mn incorporation. After RTA of $Zn_{1-x}Mn_xO$ NRs in micro-Raman spectra registers an increasing intensity and decreasing half-width at half maximum of E_2^{low} та E_2^{high} modes compared with not annealed $Zn_{1-x}Mn_xO$ NRs due to the significant improvement stoichiometry both cationic and anionic sublattice in ZnO matrix. After annealing $Zn_{1-x}Mn_xO$ NRs A_1^{LO} mode reveals high frequency shift for 6 cm^{-1} compare to frequency $Zn_{1-x}Mn_xO$ NRs before annealing. Which can be explain increases the concentration of free carriers in the conduction band of $Zn_{1-x}Mn_xO$ NRs after compensated Mn^{2+}-ion native charge defects ZnO that act as traps for free carriers.