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Growth of Mn-doped ZnO thin films by rf-sputter deposition and lattice relaxation by energetic ion impact

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We have grown Mn-doped ZnO (MZO) thin films on SiO₂-glass, sapphire (Al₂O₃) and MgO (001) substrates for the substrate temperature (T_s) from room temperature (RT) to 550 °C, by using a radio-frequency (rf)-magnetron sputter deposition (off-axis) method with a Zn_{1-x}Mn_xO ($x \approx 0.05$) sintered target. X-ray diffraction (XRD) shows that MZO films are polycrystalline with hexagonal structure and has exceptionally a-axis predominant orientation for MgO at T_s above 400 °C, (110) on r-plane-cut Al₂O₃ at T_s above 150 °C and c-axis orientation otherwise. According to Rutherford backscattering spectroscopy (RBS) of 1.8 MeV He ions, Mn/Zn is 6 % and the composition is nearly stoichiometric. MZO films have high resistivity ($\sim 1 \text{ M}\Omega\text{cm}$) and paramagnetism. It is found that for MZO films on SiO₂, the XRD intensity decreases with increasing the deviation of lattice parameter of thin films from the bulk value. Optical properties, and observations of lattice relaxation and resistivity modification by energetic ion impact are also described.

Keywords: ZnO:Mn thin films; Growth orientation; Electric, optical and magnetic properties; Lattice relaxation by energetic ion impact

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