Waveguiding Regime Control by Varying the Refractive Index for MgZnO Sprayed Thin Films

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In this work, ZnO and MgZnO thin films were deposited onto glass substrates by spray pyrolysis processes. The structural, optical, electrical, and waveguiding properties of the films were studied over Mg doping levels ranging from 0 to 30 at.%. With an increase of Mg concentration up to 20 at.%, XRD investigation reveals that the films crystallize in single ZnO wurtzite structure with a preferential *c*-axis orientation. Beyond the solubility limit, phase mixture of MgO cubic rocksalt-type and ZnO wurtzite was taken place. The band gap energy increases from 3.26 to 3.53 eV as Mg concentration increases from 0 to 30 at.%. The carrier concentration considerably decreases from $5.737 \cdot 10^{14}$ to $1.111 \cdot 10^{13}\,\mathrm{cm}^{-3}$, and the resistivity drastically increases from 19 to $1688\,\Omega \cdot \mathrm{cm}$ as Mg content increases from 0 to 5 at.%. A great attention has been paid to waveguiding measurements by prism coupler technique. The films were bi-guided up to 15%, single-guided at 20%, and none-guided transverse electric/transverse magnetic polarized modes at 30 at.% of Mg concentration. Simultaneously, the refractive index was found to be decreased with Mg doping.

Keywords: MgZnO, spray pyrolysis, band gap, waveguide, refractive index.

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