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Investigation of structural and optical properties of aluminium doped zinc oxide thin films

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Transparent conducting oxide materials are widely used in devices such as touch screens, liquid crystal displays, organic solar cells and light emitting diodes. In this study, zinc oxide (ZnO) and Al doped zinc oxide (AZO) thin films were deposited on glass substrates using a constructed spray pyrolysis system. Spray coating was done at 350 °C and thin films were annealed at 400 °C to improve the crystallinity of the thin films. Zinc acetate, methanol, deionized water and aluminium chloride were used as chemical reagents for the precursor solutions. The structural and optical properties of the coated thin films were studied by varying Al concentration from 1 to 5 % in the precursor solutions. XRD (D-8 Advance Bruker) analyses revealed that the coated ZnO and AZO thin films had retained the hexagonal wurtzite structure. Crystallite sizes of thin films were calculated using Scherrer's formula as 18.2 nm for undoped ZnO. Furthermore, it was discovered that the crystallite size decreases as the Al concentration increases. Moreover, the growth of the thin films was observed along the (100), (002) and (101) planes. UV-Visible (UV-1800 Shimadzu double beam spectrophotometer) spectroscopic data confirmed that all the thin films had exhibited 80 % or exceeded transmittance and low absorbance in the visible range, which made them suitable candidates for solar cell applications. Optical energy bandgaps of the thin films were calculated using alternative Tauc relations and they were found in the range from 3.327 – 3.358 eV. Moreover, it was found that the optical bandgap increases with the increase in Al concentration due to the Burstein-Moss effect.

Keywords: *Al-doped ZnO, spray pyrolysis, crystallite size, optical bandgaps.*