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| **Title:** | Empirical Analysis of the SAC-OCDMA-WDM System by Leveraging the AND Subtraction Technique | | | |
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| **Published Journal Name:** | **AJSE** | | | |
| **Type of Publication:** | Journal | | | |
| **Volume:** | 23 | | Issue | 2 |
| **Publisher:** | AJSE | | | |
| **Publication Date:** | 30th August 2024 | | | |
| **ISSN:** | | p-ISSN 1608-3679, e-ISSN 2520-4890 | | |
| **DOI:** | [10.53799/ajse.v23i2.1147](https://doi.org/10.53799/ajse.v23i2.1147) | | | |
| **URL:** | <https://doi.org/10.53799/ajse.v23i2.1147> | | | |
| **Other Related Info.:** |  | | | |
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| **Abstract:** |  |
| This study investigates the structural, morphological, optical, and electrical  characteristics of Al3+ and Sn4+ doped ZnO nano-crystalline thin films fabricated  using a sol–gel spin coating technique. The thin-films, with a uniform thickness of  200 nm (2% fabrication tolerance), were analyzed using scanning electron microscopy (SEM) and x-ray diffractometry (XRD) to evaluate surface profilometry, uniformity, and material compositions. The structural analysis revealed gradually improved crystalline properties up to 6 at.% Al doping and 4 at.% Sn doping, beyond which crystallinity deteriorated. Optical parameters, including optical conductivity, bandgaps, absorption index, and dielectric indices, were determined using an ultraviolet-visible (UV–Vis) spectrophotometer. The absorption indices (higher range in 0.0043–0.0046 mm for 2 at.% AZO) exhibited a non-linear relationship with bandgap energies in both types of films. The films demonstrated high mean transmittance (96%) and small grain size (~ 20 nm), indicating their suitability for various optoelectronic applications. The films also exhibited low carrier concentration rates, with specific concentrations showing optimal mobility and resistivity values. The highest and lowest FoM values were identified as 850 (10–6 Ω−1) for 6 at.% Sn and 1.06 (10–6 Ω−1) respectively. The study provides a rare comparison between AZO and SZO thin films, providing valuable insights into the enhanced properties of Al3+ and Sn4+ doped ZnO thin films, emphasizing their potential for diverse technological applications (e.g. optoelectronic devices and organic solar cells) used as conductive oxides and optically transparent electrode | |