Abstract number 21

Fabrication and Characterization of Aluminum and Gallium Mono- and Co-doped Zinc Oxide Thin Films by Radio Frequency Sputtering For photovoltaic Applications

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There is need to provide low resistivity ZnO transparent conducting thin films by radio frequency (rf) magnetron sputtering technique for commercial photovoltaic applications. Rf magnetron sputtering technique has comparative advantages such as ease of large-area deposition, low deposition temperature, high deposition rate, good adhesion between film and substrate, good surface uniformity, and simple equipment. However, ZnO thin films prepared by rf magnetron sputtering face the challenge of stagnation in the lowest achievable resistivity values even for doped ZnO thin films. The lowest resistivity values are of the order 10^{-3} Ωcm and 10^{-4} Ωcm for undoped and doped ZnO films, respectively. Aluminum (Al) and Gallium (Ga) elements are some of the leading dopants giving resistivity values only up to as low as 10^{-4} Ωc m. lowering these values farther to the order 10^{-5} Ωcm is critical for the commercial application of ZnO thin films in the photovoltaic industry. A further attempt to optimize electrical and optical properties for n-type conductivity is suggested by co-doping ZnO with two metal elements and there is scanty research on it. The study is dedicated to fabrication of undoped (pure), mono-doped (Al, Ga) and Al-Ga co-doped ZnO thin films by rf magnetron sputtering technique and their characterization for structural, electrical and optical properties. The best films will be tested for photovoltaic applications.