World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:18, No:12, 2024

Strategies to Synthesize Ambient Stable Ultrathin Ag Film Supported on Oxide Substrate

Authors : Allamula Ashok, Peela Lasya, Daljin Jacob, P. Muhammed Razi, Satyesh Kumar Yadav

Abstract : We report zinc (Zn) as a seed layer material and a need for a specific disposition sequence to grow ultrathin silver (Ag) films on quartz (SiO_2). Ag films of thickness 4, 6, 8 and 10 nm were deposited by DC magnetron sputtering without and with Zn seed layer thickness of 1, 2 and 4 nm. The effect of Zn seed layer thickness and its annealing on the surface morphology, sheet resistance, and stability of ultrathin Ag films is investigated. We show that by increasing Zn seed layer thickness from 1 to 2 nm, there is a 5-order reduction in sheet resistance of 6 nm Ag films. We find that annealing of the seed layer is crucial to achieving stability of ultrathin Ag films. 6 nm Ag film with 2 nm Zn is unstable to 100 oC annealing, while the 6 nm Ag film with annealed 2 nm Zn seed layer is stable. 2 nm Zn seeded 8 nm Ag film maintained a constant sheet resistance of 7 Ω/□ for all 6 months of exposure to ambient conditions. Among the ultrathin film grown, 8nm Ag film with 2nm Zn seed layer had the best figure of merit with sheet resistance of 7 Ω/□, mean absolute surface roughness (Ra) ~1 nm, and optical transparency of 61 %. Such stable exposed ultrathin Ag films can find applications as catalysts, sensors, and transparent and conductive electrodes for solar cells, LEDs and plasmonic devices.

Keywords : ultrathin Ag films, magnetron sputtering, thermal stability, seed layer, exposed silver, zinc.
Conference Title : ICTFTA 2024 : International Conference on Thin Film Technology and Applications
Conference Location : Tokyo, Japan
Conference Dates : December 02-03, 2024