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Electro-optical properties of transparent conducting oxide cadmium stannate thin films

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Cadmium stannate Cd_2SnO4 (CTO) thin films were characterized using spectroscopic ellipsometry (SE) along with Hall probe and X-ray diffraction (XRD) data in order to investigate correlations between deposition process parameters and thin film optical and electrical properties. The goal of this study was to determine the best possible processing method that would provide the highest optical transmission while maintaining good electrical conductivity. These CTO films were deposited on borosilicate glass using magnetron sputtering under substrate temperatures of ~ 25 °C (room temp), 200 °C, 300 °C and 400 °C. After deposition, the films were annealed in contact with cadmium sulfide (CdS). This contact CdS source came from a separate borosilicate plate coated with CdS and placed film side down on top of the CTO film during the anneal. The CTO film along with the CdS cover plate were heated to a temperature of 600 °C and annealed for one hour. In order to understand possible correlations between process parameters and thin film properties characterization was done before and after thermal anneal. SE analysis over a spectral range of 0.73 to 3.34 eV illustrated how some films drastically changed with post deposition anneal while films at different substrate deposition temperatures had marginal difference after annealing. SE results were corroborated using secondary measurements. Electrical properties were investigated using Drude modeling of SE spectra in tandem with Hall probe measurements. Structural properties of the films were analyzed using XRD. The result of this work was that the deposition and annealing processes were optimized yielding a high quality CTO thin film with a sheet resistance of ~ 8 Ω/□.

Keywords: photovoltaic; semiconductor; TCO; ellipsometry, CTO