Optimizing the Selenization Temperature for Rapid Thermal Processing of Sb_2Se_3 Absorbers

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Antimony selenide (Sb_2Se_3) is a promising absorbing material for solar cells. It has attracted intense interest by researchers worldwide because of its suitable bandgap (1.1−1.3 eV), high absorption coefficient, and good carrier mobility. In the present work, metallic antimony (Sb) layers were deposited using DC sputtering, followed by the deposition of a 1 µm thick selenium (Se) layer on top of the Sb layers. Finally, the bilayers were selenized at different temperatures (200-500°C) in a rapid thermal process (RTP) system to get Sb_2Se_3 absorbers. The XRD patterns revealed that the films selenized at a temperature of 400°C showed good crystallinity with (221) as preferred orientations related to the orthorhombic crystal structure, respectively. The Raman scattering spectra showed the characteristics modes of Sb_2Se_3 at 188, 210, and 253 cm^{-1}. The SEM, optical, and electrical studies confirmed that selenization temperature of 400°C showed a uniform and smooth surface with a band gap of 1.2 eV and p-type conductivity. Thus, our work established decisively that the generated Sb_2Se_3 thin films were acceptable for use in thin film solar cells.