Non-sulfurization single solution approach to synthesize czts thin films

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Abstrak

The growth and crystallization processes of the Cu2ZnSnS4 (CZTS) phase typically rely on high-temperature sulfurization, which involves a harmful chalcogen-containing atmosphere. Together with the use of high-toxicity solvents, these processes could hinder the widespread adoption of this technology in the mass production of CZTS semiconductors for solar cell application. Thus, we studied the formation of CZTS films from ethanol-based precursors without the sulfurization step, fully employing the non-toxic solvent and avoiding the environmentally harmful sulfur-containing atmosphere. The certain addition of 2-mercaptopropionic acid led to the formation of a clear and stable sulfur-containing precursor. The precursors were successfully deposited onto soda lime glass by employing spin coater. CZTS crystallinity in the identified XRD patterns was vanishingly small in the case of eliminating the sulfurization process. Moreover, the carbon concentration and grain size of the resulting films were controlled by changing the time period of drying treatment during film fabrication. A drying time of 120 minutes, which demonstrated a CZTS grain size of ± 1 μm with a direct optical energy gap around 1.4 eV, was confirmed as the ideal condition. These results may provide a useful route toward environment-friendly strategies for the production of a CZTS semiconductor that is compatible with the absorber application in thin-film solar cells.