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Electrodeposition mechanism of quaternary compounds Cu_2ZnSnS_4: effect of the additives

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Abstract

The electrodeposition mechanism of pure phase Cu_2ZnSnS_4 (CZTS) thin film with subsequent annealing was investigated in detail. An electrolyte design principle of quaternary compounds was proposed. The complex ions of $Cu(H_2C_6H_5O_7)^+$, $Cu_2(C_6H_5O_7)^+$, $Zn(C_4H_5O_6)^+$, $Sn(H_2C_6H_5O_7)^+$ and $Sn_2(C_6H_5O_7)^+$, which influenced the reduction process and played important roles in co-deposition, were identified by UV spectra. Electrochemical studies indicated that trisodium citrate and tartaric acid could narrow the co-deposition potential range of the four elements to -0.8 V~-1.2 V (*vs*. SCE). The cause was the synergetic effect that trisodium citrate inhibited the reduction of Cu^{2+} and Sn^{2+} and tartaric acid promoted the reduction of Zn^{2+}. The reduction of $S_2O_3^{2-}$ was mainly attributed to the induction effect of the metallic ions, and the H^+ dissociated from tartaric acid could also promote the cathode process of