

Growth characteristics of electrochemical deposited Cu_2O thin film onto $\text{Pt/SiO}_2/\text{Si}$ substrate by galvanostatic technique

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Cuprous oxide (Cu_2O) and related materials have received considerable attention in recent years for their interesting electrical and optical properties^[1-3]. In the present study, a dense and uniform Cu_2O thin film was electrodeposited onto $\text{Pt/SiO}_2/\text{Si}$ substrate from alkaline solution of Cu (II) lactate at room temperature under a low current density of $0.05\text{mA}/\text{cm}^2$. A typical cross-sectional SEM micrograph is shown in Fig.1. The structural characterization conducted by XRD indicated that the cuprous oxide with simple cubic structure was obtained. The X-ray photoelectron spectral (XPS) analysis also shows the photoelectron spectrum of Cu^{1}_{2p} . After corrected with reference of C^{1}_{s} (284.6eV), and compared with the binding energy of $\text{Cu}^{3/2}_{2p}$, the peak at 932.2eV is in agreement with that of Cu_2O ^[4]. The results of XRD shown in Fig.2 and XPS result excluded the appearance of CuO . The surface morphologies under different solution pH values were observed by scanning electron microscope, the microstructures indicate that the nanocrystalline cuprous oxide with a grain size of 60nm, 90nm, and 130nm was formed at pH= 9, 10 and 11, respectively. The variation of thickness with deposition time was also measured. As shown in Fig.3, with the increase of pH of alkaline solution, approximate linearly deposition rate of 3.5nm/min, 4.0nm/min and 4.3nm/min as pH from 9 and 10 to 11, respectively, were obtained. As described by Switzer etc.^[2], Cu_2O is formed by the reaction between Cu^{2+} and OH^- . Thus, the enhancement of Cu_2O growth at the higher pH value during electrochemical deposition is expected. More growth characteristics of Cu_2O at different temperature and the related electrochemical and optical properties are in progress.

References

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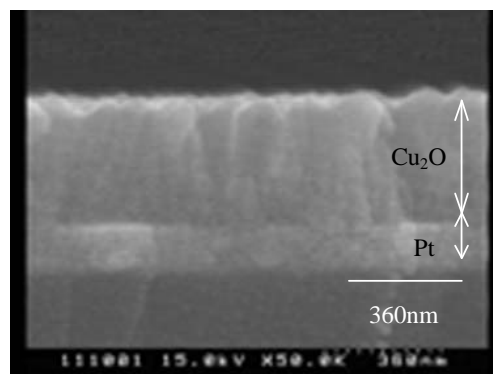


Fig.1 A typical cross-sectional SEM micrograph of electrochemically deposited Cu_2O thin film onto $\text{Pt/SiO}_2/\text{Si}$ substrate. (pH=11.0, deposition time=90min).

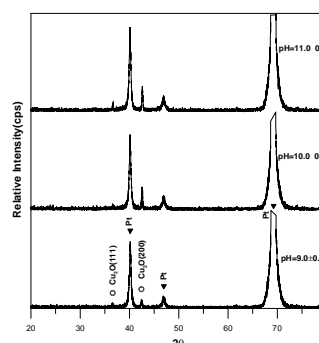


Fig.2 The XRD patterns for electrochemical deposited Cu_2O thin film at different pH values.

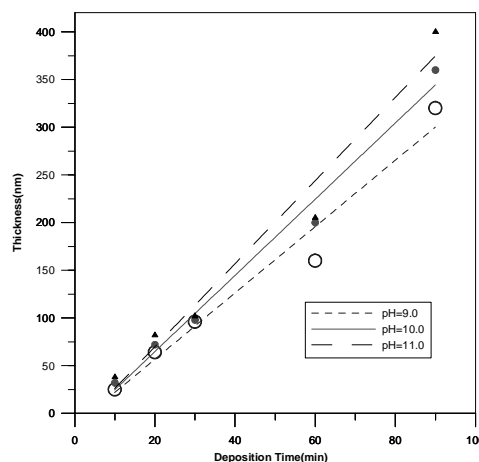


Fig.3 The dependence of deposited thickness of cuprous oxide with deposition time at different pH values.