Electrodeposition and Nanoscale Characterization of $CuInSe_2$ on Flexible Polymer for Applications in Thin film Solar Cells

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Electrodeposition of copper indium diselenide ($CuInSe_2$) (CIS) thin films has attracted research interests for its easy and cost effective approach to produce large area of films at room temperature for solar cell applications.[1-3] Several published works demonstrated a considerable influence of the deposition potential and bath composition on the atomic composition of In, Se and Cu present in the film. Despite the efforts and progress made in the electrodeposition of $CuInSe_2$, many other fundamental aspects of electrodeposition of the thin film remain unexplained– including the influence of substrates other than Mo, bath transport properties etc. In addition, methods for producing large areas of film must to be scale up for a commercial fabrication. Our method involves a combination of electroless and electrolytic routes, and does not require use of expensive sputter coating equipment, therefore the manufacturing can be accomplished at a very low cost.

The effects of the hydrostatic condition for plating CIS on polymer substrate metallized with nickel were studied. A flexible polymer (polyimide, mylar) was catalyzed, activated, and electroless nickel plated. The electroless nickel served as the electrode for the deposition of CIS. The CIS bath is 10 mM Cu^{2+}, 5 mM In^{3+} and 10 mM Se^{4+} at pH 2.5 in aqueous solution. Figure 1 shows AFM images of CIS electrodeposited on electroless nickel at a constant potential of -0.7 V (vs. Ag/AgCl) in stirred and still bath. The CIS is also electrodeposited onto same substrate with various flow recirculating rate. Films are annealed at various temperature and time for improved crystallinity. Fig. 2 shows EDS analysis of CIS composition at different recirculating rate electrodeposited with various annealing time. The effects of hydrostatic conditions, annealing temperature, and annealing duration on the composition and nanostructure of the CIS thin films will be presented.

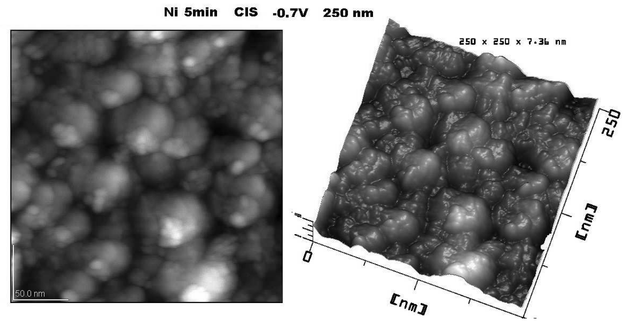

Fig. 1a

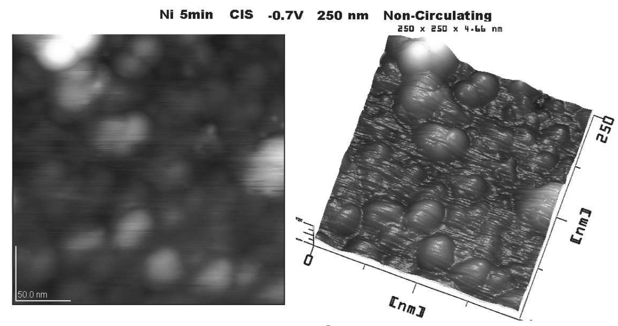

Fig 1b

Fig.1a (Top): AFM image of CIS electrodeposited at -0.7V in stirred bath. 1b (Bottom): AFM image of CIS electrodeposited at -0.7V in still bath.

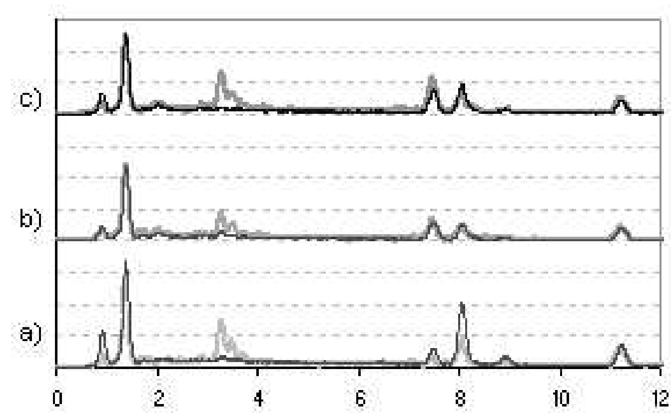

Fig.2: EDS Analysis of CIS electrodeposited at -0.6V in flow rate of 3.3mL/s and 6.2mL/s and a) as-deposited b) annealed in 270C for 15 min c) annealed in 270°C for 45 min. Darker color is 6.2mL/s

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