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Influence of annealing conditions on the properties of Cu(In,Ga)Se_2 thin films fabricated by electrodeposition

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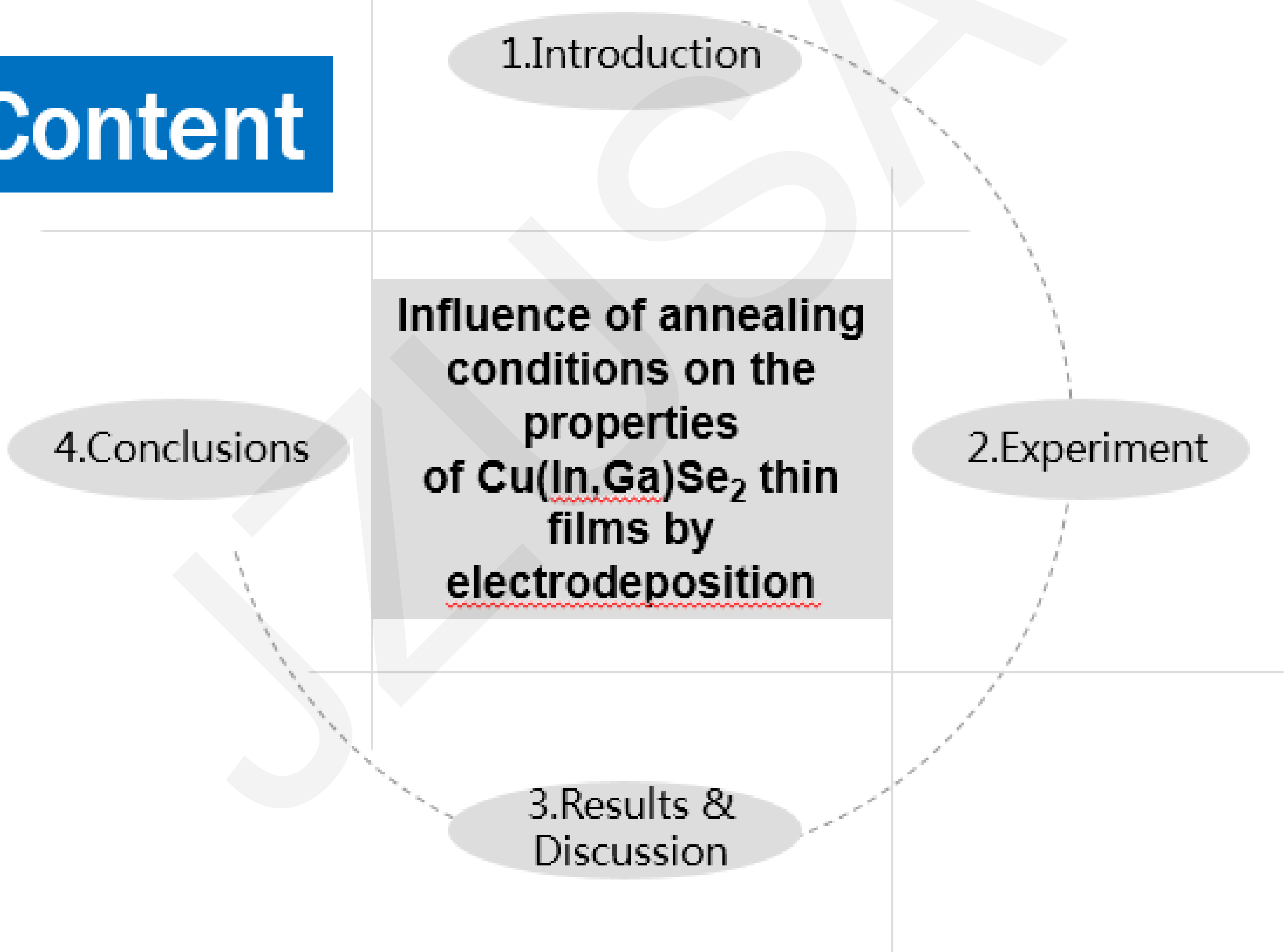
Content



1.Introduction

Influence of annealing conditions on the properties of $Cu(In,Ga)Se_2$ thin films by electrodeposition

2.Experiment

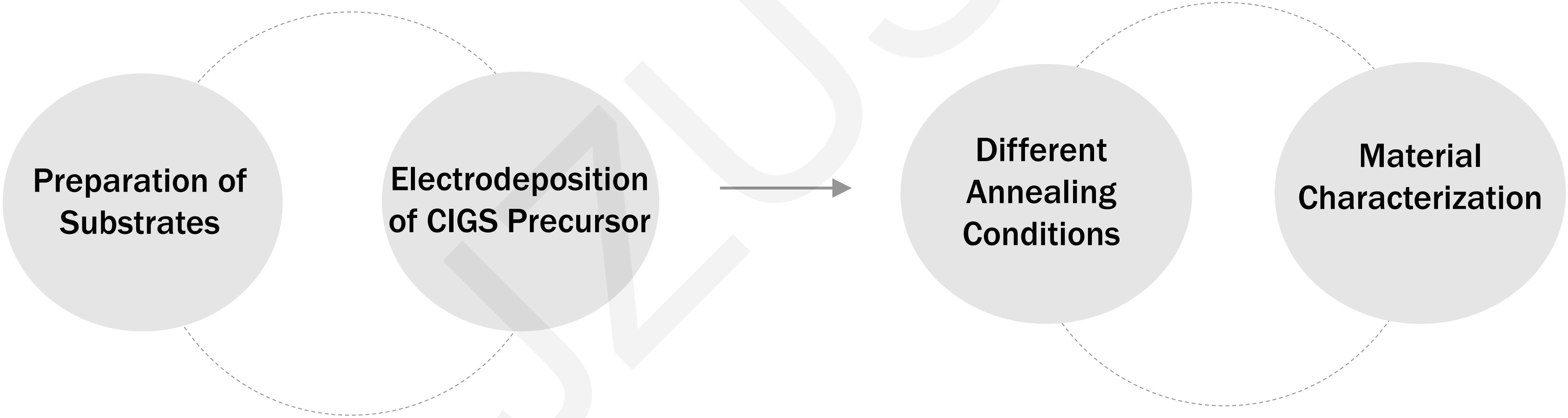
3.Results & Discussion

4.Conclusions

Introduction

CIGS precursor films were fabricated by electrodeposition and then the effects of selenization temperatures and heating rates on the properties of the films were investigated. X-ray diffraction (XRD) spectra, scanning electron microscopy (SEM) and Raman scattering spectroscopy were used to investigate the components and structure of the films under different conditions.

Experimental Procedure



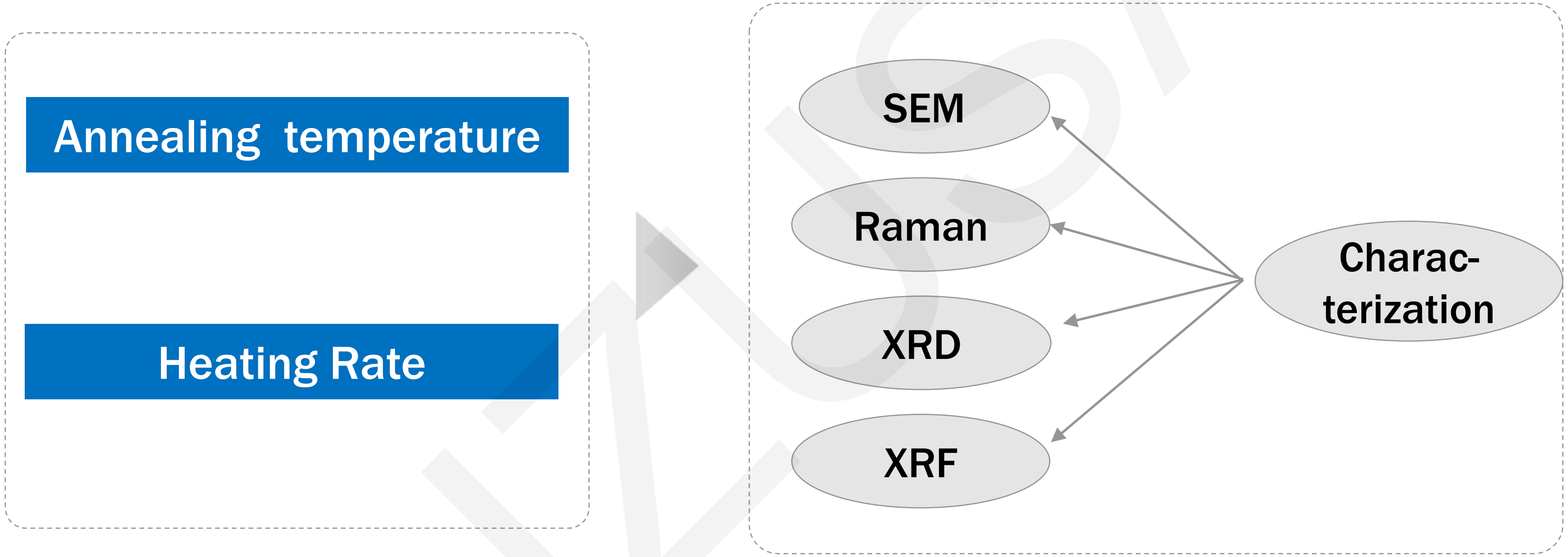
Preparation of Substrates

Electrodeposition of CIGS Precursor

Different Annealing Conditions

Material Characterization

- **Method**



Annealing temperature

Heating Rate

SEM

Raman

XRD

XRF

Charac-terization

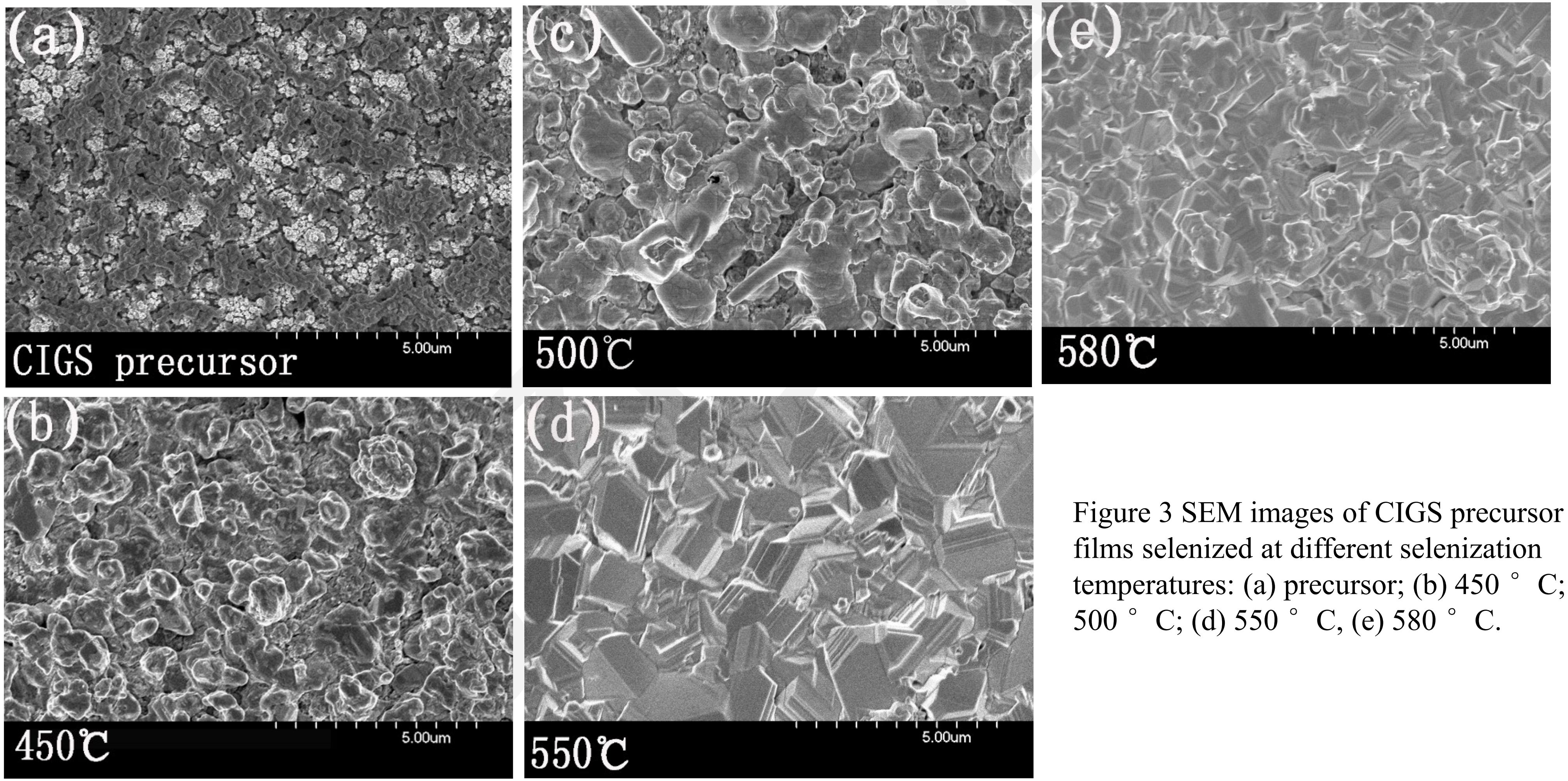


Figure 3 SEM images of CIGS precursor and films selenized at different selenization temperatures: (a) precursor; (b) 450 ° C; (c) 500 ° C; (d) 550 ° C, (e) 580 ° C.

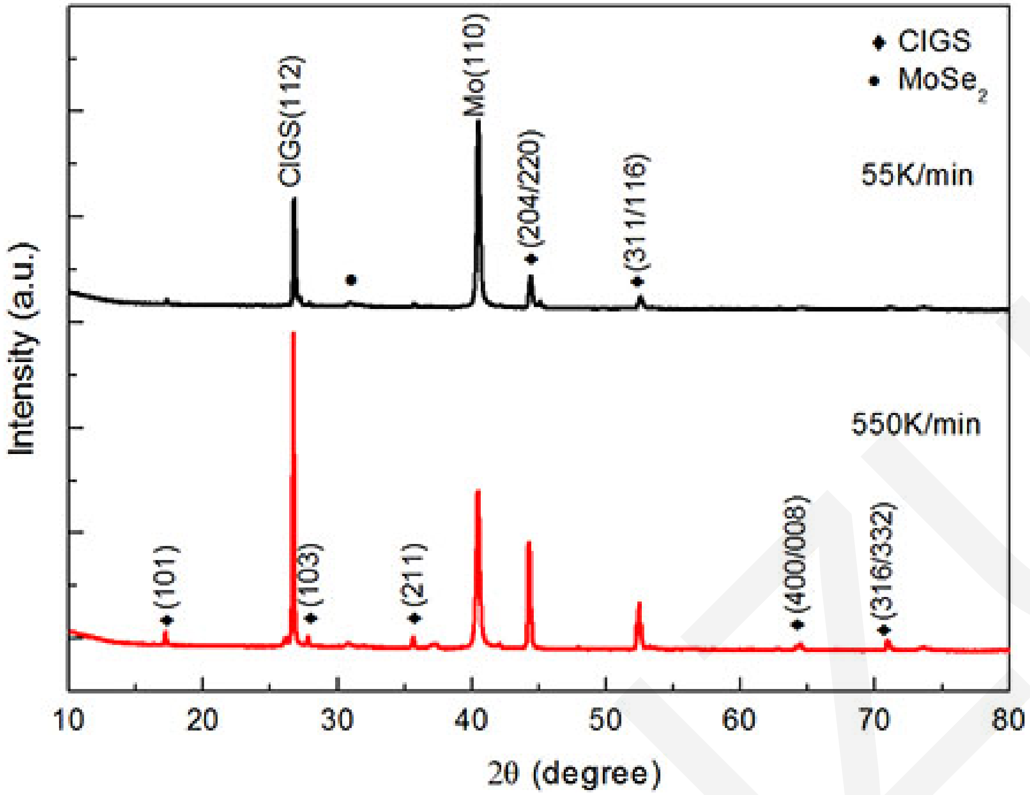


Figure 4 XRD patterns of of CIGS films selenized at 550℃ for 1h with different heating rates

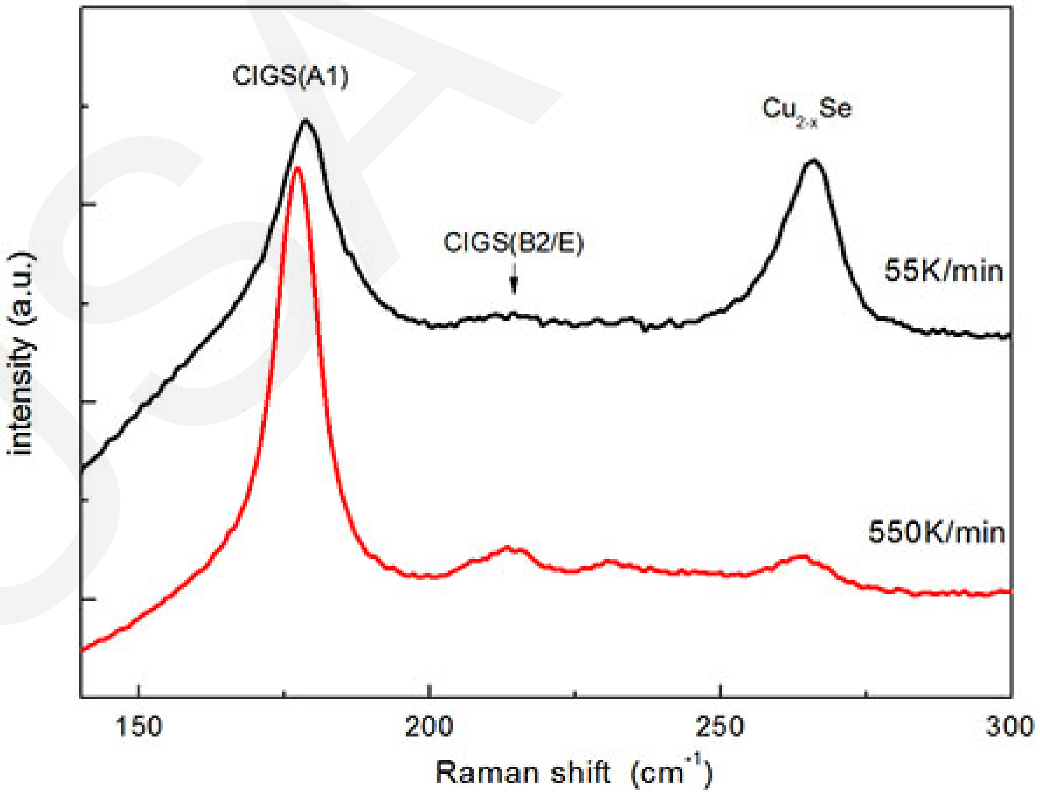


Figure 5 Raman spectra of CIGS films selenized at 550 ° C for 1h with different heating rates

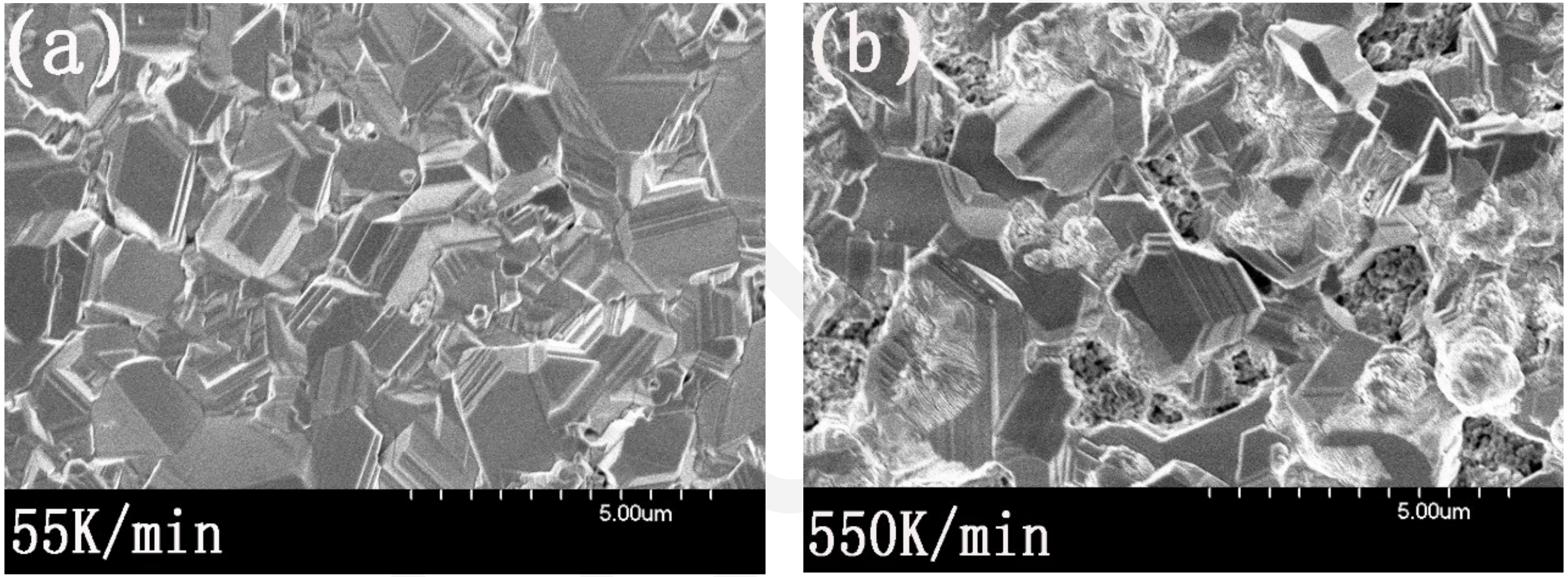


Figure 6 SEM images of CIGS films selenized at different 550° C for 1h with different heating rates (a) 55K/min, (b) 550K/min

Conclusion

- The ratios of Cu/(In+Ga) and Ga/(In+Ga) are likely to increase with elevated selenization temperature.
- As annealing temperature ranges from 450 ° C to 550 ° C, the improvement of film crystallinity is due to the increase of Cu_2Se phase, but the amount of binary Cu-Se phase decreases. After annealing at 580 ° C, minimum amount of $Cu_{2-x}Se$ compounds were obtained and the degree of CIGS film crystallinity was higher than other samples.
- For the samples treated by fast heating, the ratio of Cu/(In+Ga) was slightly lower than samples treated by slow heating. The ratio of Ga/(In+Ga) remained unchanged.
- Crystallinity of the films improved noticeably with the increase of heating rate as well as the grain size became larger.