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MDPI

Formation and microstructural characterization of copper oxide thin films

THE UNIVERSITY OF SHIGA PREFECTURE
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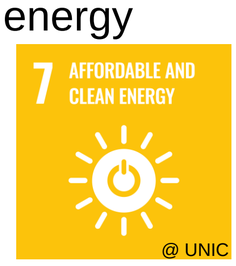
INTRODUCTION & AIM

Renewable energy

Increase of energy demand → Utilization of new energy
ex.) **Solar**, wind, hydro, geothermal, biomass
→ Research on **solar cells** is especially active.



Solar cells

・Perovskite (Organic-inorganic hybrid crystal)
Flexible structure, high conversion efficiencies
Cons. Low stability ・High cost
↓

CuO device

・Highly stable crystal and lower toxicity
・Complex deposition methods ・High temperature annealing
・Improvement of electrical properties by doping elements

Aim

CuO thin films were fabricated using a simple spin-coating method, which will help in their application to solar cells.

METHOD

Solutions

Compact TiO_2 precursor solution : Ti diisopropoxide bis (acetyl acetonate) and 1-butanol were mixed.

Mesoporous TiO_2 precursor solution : Mainly, it was prepared by mixing titanium oxide powder with pure water.

CuO precursor solution : $CuCl_2$ was dissolved in pure water and then mixed with a surfactant.

Mg-added CuO precursor solution : $CuCl_2$ and $MgCl_2$ were mixed with CuO solution at their desirable concentrations.

Fabrications

1. Compact TiO_2 solution was spin-coated and dried twice on a cleaned FTO substrate and annealed.
2. Mesoporous TiO_2 solution was spin-coated and annealed.
3. CuO solution was spin-coated and annealed under various conditions such as spin-coating times, annealing temperature and time.
4. Gold (Au) was deposited for the device electrode.

RESULTS & DISCUSSION

Microstructures

・Observation of strong XRD peaks derived from CuO
・$MgCu_2O_3$-derived peak around 36.8˚

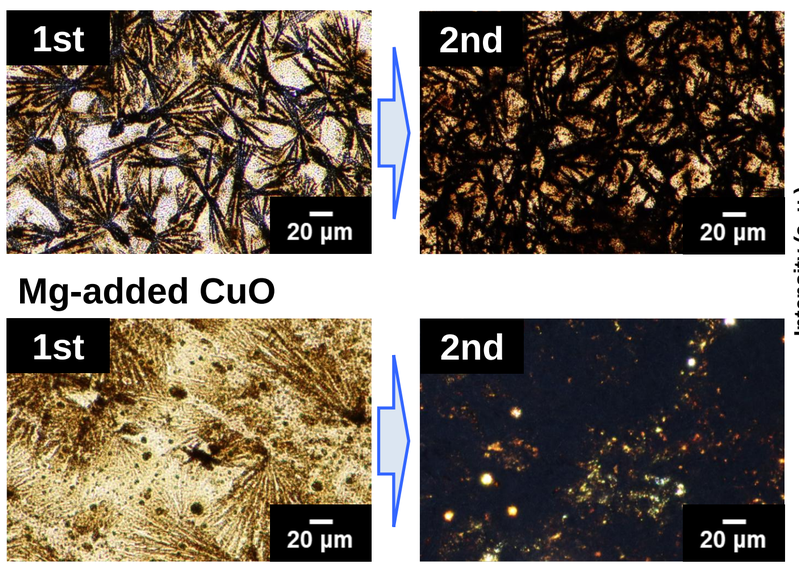
Surface morphology observation

・Decrease in void area due to two deposition operations
・CuO: Flower-shaped crystals with spreading pillar structure
・Confirmation that photoelectric conversion is possible upon light irradiation (Current density-voltage measurements)

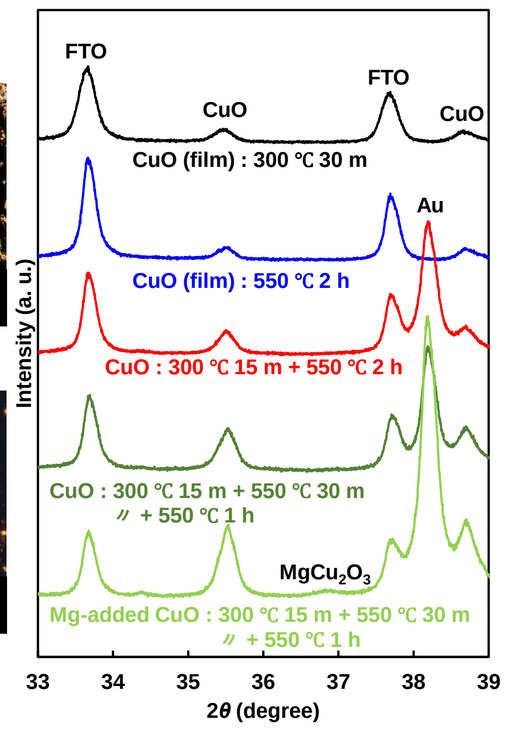
⇒ **Spin-coating and annealing twice each are necessary for uniform thin film formation.**

Optical microscopy

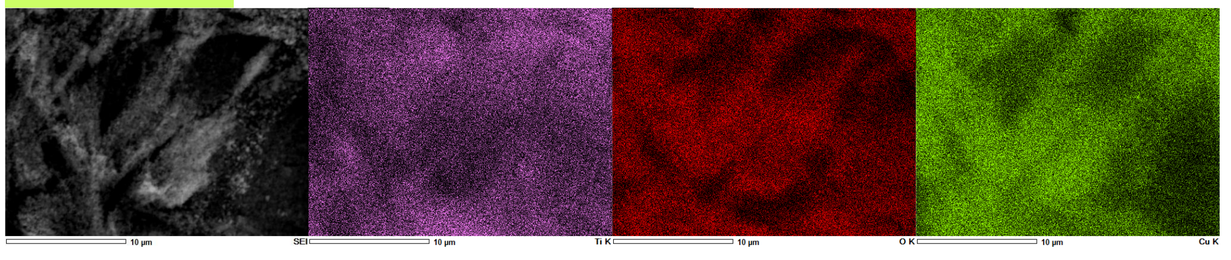
CuO



X-ray diffraction



SEM EDS CuO film



CONCLUSION

- Copper oxide thin films were successfully deposited using a spin-coating method.
- CuO-derived peaks were observed in the fabricated thin films, indicating that spin-coating and annealing twice is effective for achieving uniform film formation.

→ The spin-coated CuO thin films demonstrated potential for application in solar cells and provided a foundation for future optimization of thin film fabrication processes.