Morphology of Copper Tin Sulfide Films Grown by Pulsed Laser Deposition at 248 and 355 nm

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SnS-enriched Cu2SnS3 films

Discussion and conclusion

- SEM images reveal that CTS and SnS-enriched CTS absorber layers have droplets ranging from hundreds of nanometers up to several micrometers.
- A lower irradiation wavelength (higher photon energy) does not reduce the density or size of the droplets.
- Droplets are generally Sn and S-poor suggesting losses of volatile elements during re-crystallization of the molten agglomerates arising from the ablation process.
- Annealing reduces considerably the size and distribution of droplets; however, local non-uniformity composition may be retained in the annealed films.
- Bubbles are present on the surface of the annealed films, most probably resulting from evaporation of SnS.
- Further studies will be carried out to understand the influence of droplets on the performance of the solar cells and also to reduce their density by optimization of the PLD process.

The Pulsed Laser Deposition Route

<table>
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<tr>
<th>Wavelength (nm)</th>
<th>Deposition rate (Cu2SnS3)</th>
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<tbody>
<tr>
<td>355</td>
<td>~2.2 J/cm² F=0.4 ( \times ) cm² (target-substrate dist.)</td>
</tr>
<tr>
<td>248</td>
<td>~10Hz</td>
</tr>
<tr>
<td>2.2</td>
<td>F=0.4 2.2 ( \times ) cm²</td>
</tr>
<tr>
<td>F=0.4 ( \times ) 2.3 J/cm² D=4.5 cm</td>
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Surface morphology

Annealing of CTS and SnS enriched-CTS

Figure 3: SEM images (top and side view) of as-deposited Cu2SnS3 films on Mo-coated soda-lime glass

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References