Ultrashort pulse laser scribing of thin film solar cells

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Preliminary tests of picosecond laser scribing in $CuInGaSe_2$ solar cells manufacturing have been performed. SEM image and EDAX analysis confirm the scribing quality, while the comparison with mechanically scribed solar cells are in progress.
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1. Introduction

Laser scribing represents the most useful technique for the processing of new generation photovoltaic cells. The manufacturing process of thin-film solar cells on alternative substrates, such as flexible metallic or polymeric sheets, or ultra-thin glasses, is characterized by the problem of damaging the cells by mechanical scribing.
Cu(InGa)Se2 (CIGS) is one of the most promising semiconductor material for thin-film solar cells, due to its high absorption coefficient and theoretical photoelectric conversion efficiency of 27% [1]; for the processing of CIGS-based solar cells, the laser scribing is the most efficient approach [2].
In this work, a conventional solar cell with the structure Mo/CIGS/CdS/TCO and CIGS grown by the low temperature pulsed electron deposition (LT-PED, [3]) is analysed and the laser scribing is focused on the TCO (ZnO/ZnO:Al bi-layer deposited by sputtering), which represents the P3 step in the manufacturing process.

2. Optical setup

A picosecond 1064 nm (Innolight Helios IR) laser source is used in combination with a rotary waveplate to adjust the power beam, and with a beam expander.

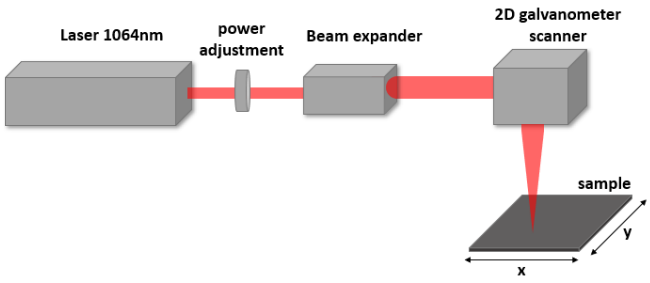

Figure 1. Schematic representation of the optical setup

A galvanometer scanner is controlled via software to perform a precise beam path (Figure 1). The power, the velocity and the repetition rate of the beam are some of the main parameters that influence the quality of the scribing.

3. Results and conclusion

High uniformity of the trace (Figure 2) confirms the good quality of the scribing meanwhile the EDAX analysis attest the removal of TCO layers. The channel width is about 130 µm.

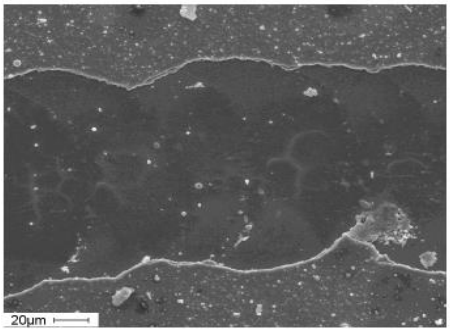

Figure 2. Scribing of CIGS solar cell. Mark speed = 1000 mm/s, pulse rate 30 kHz, peak power =2,4 W

Further computation analyses and material characterizations are needed, though the quality of the scribing confirms the high reliability of the process. In particular, the correlation of the shunt (R_{SH}) and series (R_S) resistances of laser/mechanically scribed solar cells and the effect on the PV parameters are in progress.

References

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