CIGS Thin-Film Solar Cell Scribing with Atlantic Laser

Interest in complex multilayered $CuIn_xGa_{(1-x)}Se_2$ (CIGS) solar cells has increased recently because of low production costs and scalability through a roll-to-roll process. Flexible CIGS solar cells have several advantages which make them ideal candidates for space and building-integrated applications.

Efficiency of the thin-film solar cells with a large active area might be maintained if small segments are interconnected in series in order to reduce photocurrent in thin films and resistance losses. Laser scribing is an important step to preserve high efficiency of photovoltaic devices on large areas. There is still no industry-accepted laser scribing process for the CIGS thin-film solar cells.

The main limiting factor to nanosecond laser processing of the multilayer CIGS structures is deposition of molybdenum on walls of channels scribed in the films, and the phase transition of CIGS to metallic state close to the ablation area due to the thermal effect. Both effects create shunts in the photo-electric device and reduce its conversion efficiency. Thermal degradation of the CIGS solar cells starts at temperatures above 350 °C. The processing without damage is possible with ultra-short-pulse lasers.

The picosecond laser Atlantic was used to scribe the thin-film layers in CIGS solar cells with the top contact made of ITO and ZnO. Irradiation with the 355 nm laser radiation has shown better results due to selective energy coupling. Selectivity of the laser ablation with the 355 nm radiation: grains of $CuIn_xGa_{(1-x)}Se_2$ on molybdenum covered by the thin ZnO:Al top-contact. Clean removal has been confirmed by EDS analysis.

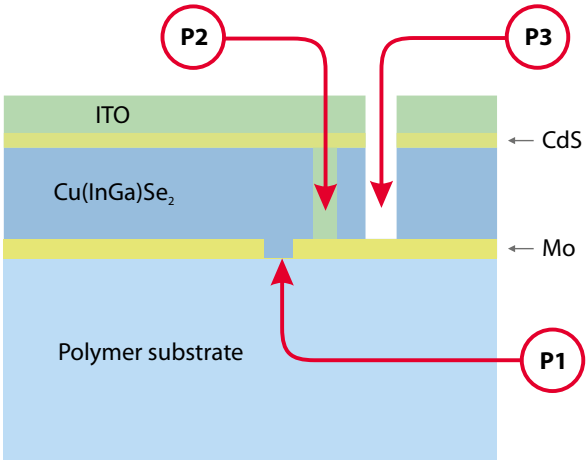

Fig 2. Solar-cell interconnect formed by laser

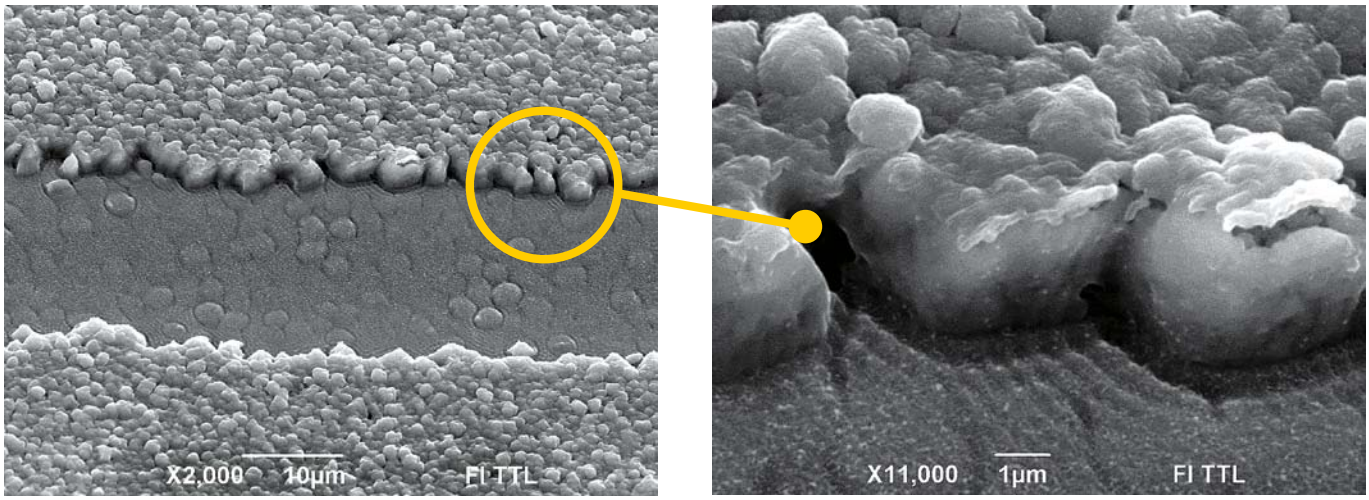

Fig. 3. SEM pictures of P3 scribes in ZnO/GIGS/Mo/PI thin-film solar cells made by picosecond laser Atlantic. Process parameters for 355 nm: 75 mW, 300 mm/s, 1 scan