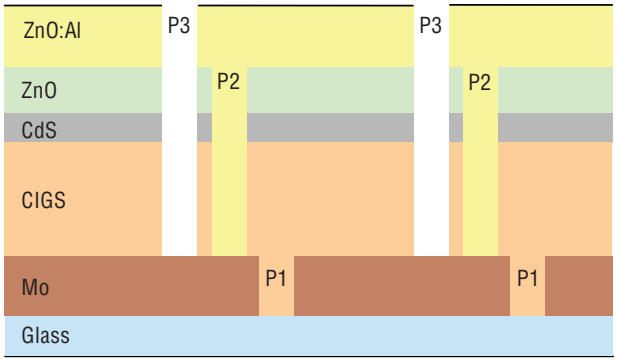
Molybdenum Scribing In CIGS TFPV Solar Cell

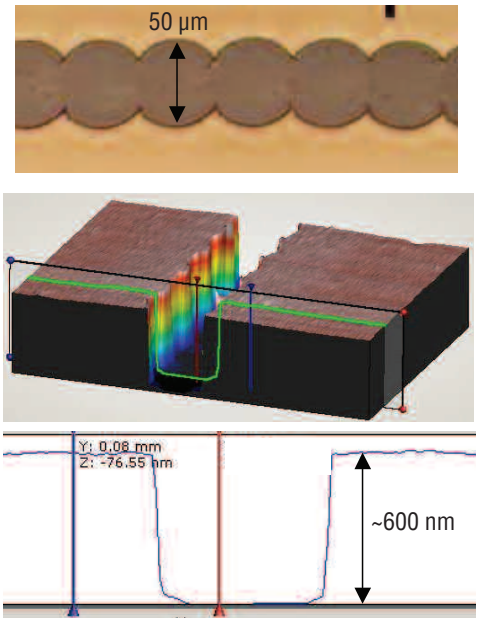
While PV manufacturers are focusing on increasing solar cell efficiencies and reducing manufacturing costs, many of them are showing interest in CIGS TF solar cell technology. In CIGS solar cells, metallic Molybdenum TF deposited on a glass substrate is used as a back contact. Typically IR or green DPSS Q-switched lasers are used to process electrically isolating scribes on Molybdenum thin films.

While the quality of Molybdenum scribes is known to be highly dependent on film deposition techniques, our research has found that laser pulse width affects the scribe quality as well. Compared to longer pulse durations (>15 ns), shorter pulse durations (8–15 ns) result in cleaner scribes with reduced burr (refer to the following Molybdenum scribe image). Process challenges also include prevention of burr and/or cracking and lifting of film along the scribe edges, and prevention of micro cracks in the glass substrate.

In the Spectra-Physics Industrial Applications Lab we have demonstrated that we can process electrically isolating good quality scribes in Molybdenum TF without damaging the underlying glass substrate.



Schematic of CIGS thin film solar cell structure



Microscope image (top) and 3D, 2D depth profile trace of P1 Moly scribe generated at 2 m/sec scan speed

The above figure shows microscope picture of scribe on 600 nm thick Molybdenum thin film. 50 µm wide P1 scribes were generated using Spectra-Physics HIPPO™ 532-11 laser at 2 m/sec scan speed using galvanometer scanner and f-theta lens. In addition to optical inspection techniques, we also characterize the quality of scribes using mechanical stylus depth profilometry. The corresponding 2D and 3D depth profiles in the above figure shows that electrically isolating high quality scribes were achieved without damage to the underlying substrate. The HIPPO laser's short pulse width allowed processing of cleaner scribes with no ridges or burrs and no evidence of lifting/cracking of the material is seen at the scribe edges.

Spectra-Physics®
A Newport Corporation Brand

Molybdenum Scribing In CIGS TFPV Solar Cell

Spectra-Physics short-pulse Q-switched lasers offer superior results for a variety of Molybdenum TF thicknesses. Depending on material removal threshold, scribe width, and throughput requirements, a wide array of Spectra-Physics 1064 nm, 532 nm and 355 nm Q-switched product families can meet the requirements, including the Navigator™ and HIPPO lasers.

Product: Navigator Laser

The Spectra-Physics Navigator family of lasers is available with pulse widths as low as 8 ns. Short pulse widths and high repetition rates enable processing materials at higher speeds with smaller heat-affected zone. This translates to higher throughput and higher yields for a manufacturing process.

Product: HIPPO Laser

Spectra-Physics' HIPPO 1064 nm and 532 nm lasers are offered at 50 kHz optimal pulse repetition frequency, making them ideal for PV scribing with high-speed beam scanning. Their high power output allows for beam-splitting to achieve higher system throughput. Add to that the short pulse width, excellent beam quality, and good pulse-to-pulse energy stability, and HIPPO lasers become ideal engines for thin film PV scribe tools.

Model	Wavelength	Peak Power	Average Power	Pulse Width	Repetition Rate (nominal)
Navigator 1064-5	1064 nm	>17.9 kW	5 W	<8 ns	35 kHz
Navigator 532-3	532 nm	>9.8 kW	>2.7 W	<8 ns at 35 kHz	35 kHz
HIPPO 1064-17	1064 nm	>22.7 kW	>17 W	<15 ns at 50 kHz	50 kHz
HIPPO 532-11	532 nm	>16.9 kW	>11 W	<13 ns at 50 kHz	50 kHz

Spectra-Physics® Lasers Sales 1-800-775-5273 sales@spectra-physics.com www.newport.com/spectra-physics

qs-03
DS-041001 (06/11)