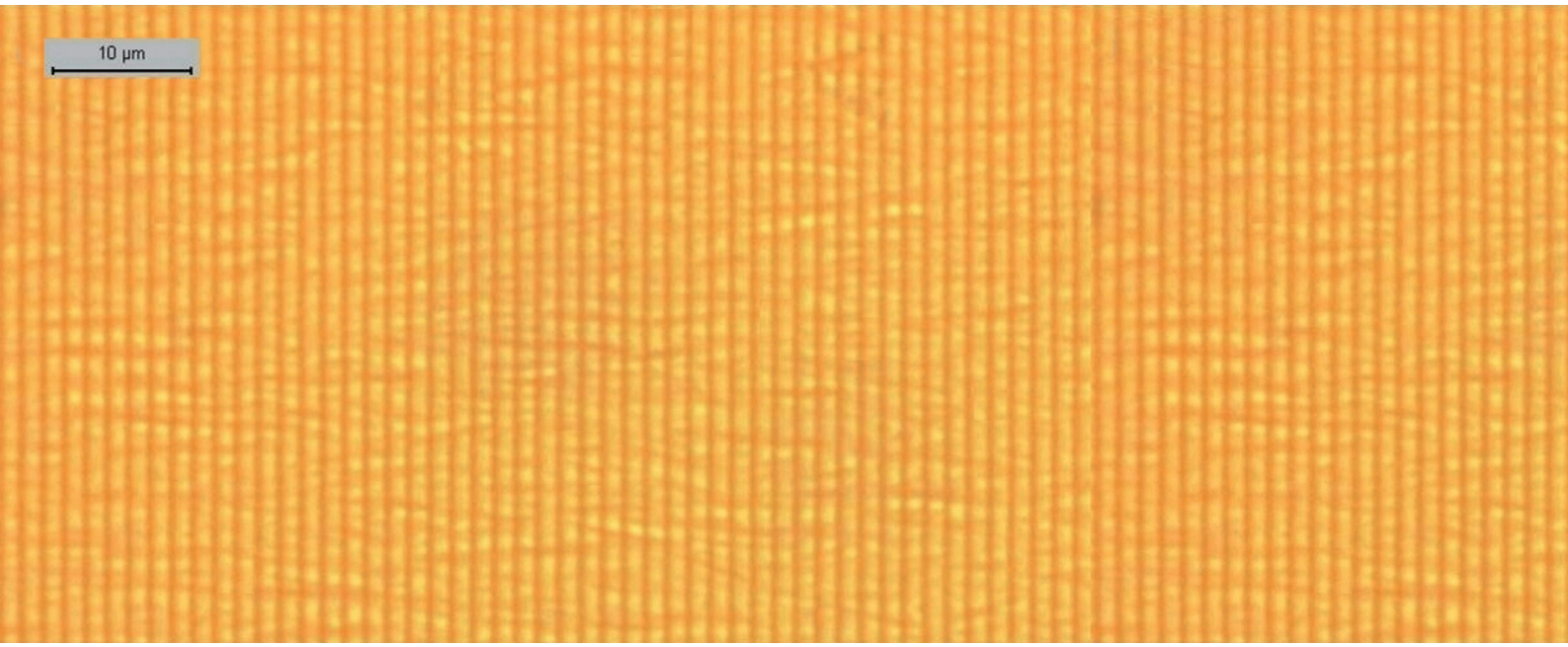
JENOPTIK

Directional and 2-shot SLS Crystallization of a-Si for Large Area Electronics



Microscope view of 50nm a-Si film directional crystallization, 900mJ/cm², 1.5µm pitch, 300ns

INNOVAVENT® LASER OPTICS

operated by JenLas® **ASAMA** Diode Pumped Thin Disk Laser

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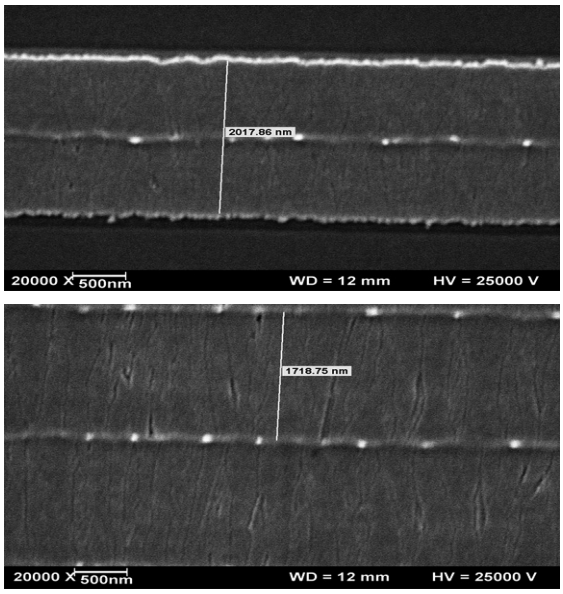
Crystallization of Thin a-Si Films

Crystallization of amorphous silicon films plays an important role in the production of LCD and OLED displays supporting the preparation of thin film transistors to switch the pixels and to integrate driver electronics, memory and CPU circuits on the glass substrate. The improved film performance gives higher electron mobility and full system on glass can be prepared.

Directional and SLS Processing

Scanning of a-Si films with a Gaussian line beam is performed to obtain directional lateral crystallization or sequential lateral solidification (SLS). The directional process grows the crystalline structure pulse by pulse with a pitch of 1-2µm in scanning direction (see picture on cover page).



SEM of SECCO etched single shot (top) and 1.75µm pitch SLS (bottom) in 50nm a-Si at 660 and 880mJ/cm², 515nm, 300ns

The single pulse structure is repeated with minimum overlay to obtain the 2-shot SLS crystallization structure. Directional and SLS processing is based on full melt of the silicon film. The typical structure of 1-3µm long crystals is generated by seeded lateral growth initiated at the liquid to solid interface.

LAVA LASER OPTICS

The LAVA LASER OPTICS creates a Gaussian line focus of 5-10µm FWHM over a length of 8mm. Large depth of focus of ~30µm is achieved due to the ASAMA anamorphic beam quality performance. The process is highly efficient. Pulse by pulse directional grains grow with a pitch of 1-2µm at 100 kHz rep.-rate. The pitch is 4-6µm for the 2-shot SLS. The pulse length of 300ns (up to 600ns by electronic setting) heats the liquid silicon film and prevents spontaneous nucleation until seeded solidification is completed. The extremely high power output stability of the ASAMA laser is a prerequisite for homogenous film quality.

Stitching in the long axis with overlay of <=5µm opens the door to seamless large area processing for G5 and larger glass sheets.

Throughput Comparison

Green laser annealing (GLA) offers for 2-shot SLS processing high throughput and reduced cost of ownership (CoO).

	FLX excimer	LAVA DPSSL
Crystallization Method	SLS 2shot	line 2shot
Laser	LSX315C	2x ASAMA 100-1
pulse energy / mJ	1050	2x 1
rep rate / Hz	300	100k
output power / W	315	200
beam size	25mm x 1.5mm	2x 8mm x 8.5µm
scan pitch / um	750	5
area/cm²/s	56,3	80
area/cm²/s per 100W power	17,9	40
scanspeed mm/s	225	500
complexity	optical pulse extender	electronic pulse length setting, no pulse extender
	substrate xy+z	p-lens with z adjustment
	toxic gas	no gas supply
stitching long axis	<=5µm ok	3~5µm ok
focusing	25mm line auto focusing	8mm line reliable auto focusing

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