



Crystallization of thin a-Si films for large area electronics

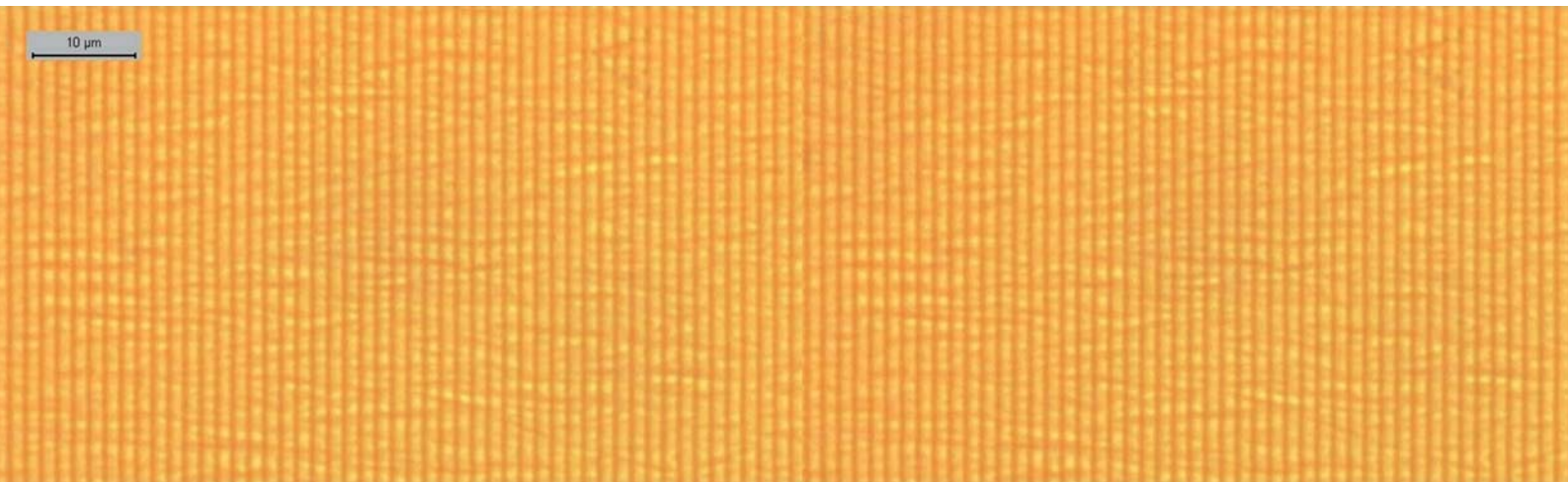


Photo: microscope photo of 50nm thick a-Si film processed at 1.5μm pitch by LAVA LASER OPTICS

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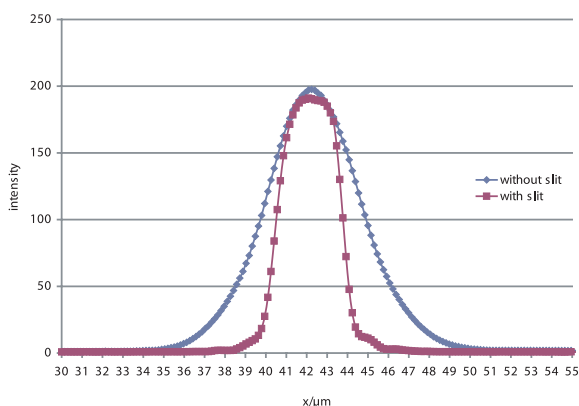
Crystallization of thin a-Si films

Crystallization of amorphous silicon films plays an important role in the production of large area electronics. LCD and OLED displays take advantage of the thin film transistor (TFT) technology to switch display pixels and place driver electronics, memory and CPU circuits directly on the glass substrate. The crystallization process enhances the electron and hole mobility of the a-Si film from 0.1 cm²/Vs to 600cm²/Vs and higher. The mobility improvement allows to prepare smaller TFTs and opens the way to higher resolution, more compact, lighter and thinner design of mobile displays. Not only pixel TFTs for LCD and OLED devices but also analog and digital drivers as well as memory and processor circuits can be arranged on the glass substrate due to the higher mobility. Full systems on glass can be prepared on the display substrate.

Green Laser Wavelength Benefits

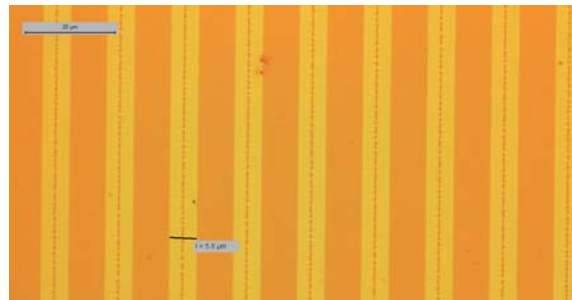
Green laser light (515nm) is well suited for annealing of thin a-Si films. The absorption of the green wavelength in silicon increases with the film temperature. Seeded crystallization is obtained by combining this efficient heating process with the pulse length range of 250 to 600ns of the JenLas[®] ASAMA laser.

The green laser light is produced by generating the



Gaussian axis profile (blue) and slit profile (red) on the a-Si film obtained with LAVA and VOLCANO LASER OPTICS with the JenLas[®] ASAMA laser

second harmonic of a diode pumped Yb:YAG thin disk laser. Power levels of 100W at high repetition rate (2mJ @ 50kHz and 8mJ @ 10kHz) and more are achieved with the JenLas[®] ASAMA laser technology.



Single pulse exposure of 50nm a-Si film at 900 mJ/cm², microscope view.

LAVA and VOLCANO LASER OPTICS

The LAVA and VOLCANO LASER OPTICS create a Gaussian line focus with a small axis FWHM of 5-10μm. A large depth of focus is achieved due to the small axis M² value of 4.5 of the JenLas[®] ASAMA laser. Along the line length of either 8mm (LAVA) or up to 100mm (VOLCANO) crystallization is seeded into the liquid silicon. The crystallization is highly efficient and grows forward pulse by pulse at a pitch of up to 2μm. The high repetition rate of 50 kHz results in preheating of the film and the glass underneath and thus suppresses spontaneous crystallization and supports seeded directional growth. The extremely high power stability of the laser is a prerequisite for homogenous film quality. Additionally, partial melt crystallization of thin a-Si films is possible with the green laser process at lower energy density (~500mJ/cm² range).

LAVA and VOLCANO LASER OPTICS give an exposure throughput of 10-16cm²/s per 100W green laser power. This compares well to excimer laser systems, which achieve comparable throughput with much higher laser power and which create Si films with larger surface roughness (i.e. 2-shot SLS) and lower electron and hole mobility.

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