Laser crystallization in active-matrix display backplane manufacturing

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Laser-based crystallization techniques are ideally-suited for forming high-quality crystalline Si films on active-matrix display backplanes, because the highly-localized energy deposition allows for transformation of the as-deposited a-Si without damaging high-temperature-intolerant glass and plastic substrates. However, certain significant and non-trivial attributes must be satisfied for a particular method and implementation to be considered manufacturing-worthy. The crystallization process step must yield a Si microstructure that permits fabrication of thin-film transistors with sufficient uniformity and performance for the intended application and, the realization and implementation of the method must meet specific requirements of viability, robustness and economy in order to be accepted in mass production environments.

In recent years, Low Temperature Polycrystalline Silicon (LTPS) has demonstrated its advantages through successful implementation in the application spaces that include highly-integrated active-matrix liquid-crystal displays (AMLCDs), cost competitive AMLCDs, and most recently, active-matrix organic light-emitting diode displays (AMOLEDs). In the mobile display market segment, LTPS continues to gain market share, as consumers demand mobile devices with higher display performance, longer battery life and reduced form factor. LTPS-based mobile displays have clearly demonstrated significant advantages in this regard.

While the benefits of LTPS for mobile phones are well recognized, other mobile electronic applications such as portable multimedia players, tablet computers, ultra-mobile personal computers and notebook computers also stand to benefit from the performance and potential cost advantages offered by LTPS.

Recently, significant efforts have been made to enable robust and cost-effective LTPS backplane manufacturing for AMOLED displays. The majority of the technical focus has been placed on ensuring the formation of extremely uniform poly-Si films. Although current commercially available AMOLED displays

are aimed primarily at mobile applications, it is expected that continued development of the technology will soon lead to larger display sizes. Since LTPS backplanes are essentially required for AMOLED displays, LTPS manufacturing technology must be ready to scale the high degree of uniformity beyond the small and medium displays sizes. It is imperative for the manufacturers of LTPS crystallization equipment to ensure that the widespread adoption of the technology is not hindered by limitations of performance, uniformity or display size.

In our presentation, we plan to present the state of the art in light sources and beam delivery systems used in high-volume manufacturing laser crystallization equipment. We will show that excimer-laser-based crystallization technologies are currently meeting the stringent requirements of AMOLED display fabrication, and are well positioned to meet the future demands for manufacturing these displays as well.