

Challenges for large area processing equipment for TFT-LCD manufacturing

Tak Tanaka

AKT, Marketing, Santa Clara, California, U.S.A

Abstract

As the manufacturing capacity needs for large size LCD TV shifts very fast into next generation, equipment manufacturers face more challenges in development of the systems which can accommodate productivity, reliability and high process quality requirements from the panel makers. AKT committed to continue its contribution to the growth of the LCD market by providing excellent PECVD products. The cost containment and performance improvement are key challenges for large size processing equipment development and this presentation discusses various challenges and AKT's solutions in developing large size PECVD equipment beyond Gen. 8.

1. Objectives and Background

Market demand of TFT LCD TV has grown fast and it is expected that LCD TV CAGR will be over 50% through 2010. The most popular size of LCD TV will shift from 30-inch to 40/50-inches and even larger. In order to meet the fast market demand growth and size expansion, equipment makers have to develop larger generation systems with relatively better system performance and lower manufacturing cost to meet the demand by panel makers.

PECVD, which forms the most critical amorphous silicon layer and dielectric layers for thin film transistor that drives the LCD, is a vacuum chemical vapor deposition system with capacitive coupled RF (radio frequency) power. In order to deposit high quality and uniformity thin films, reactive gas flow, substrate temperature, RF power, etc. are the key process control parameters need to be fine tuned. From system development point of view, such process control roots in the system engineering design.

With the fast glass substrate expansion and higher productivity expectations, the key challenges for PECVD system development is summarized as following:

- Gas delivery uniformity within huge chamber
- RF power distribution uniformity without standing wave effect for huge capacitor dimension
- Accurate, fast and smooth glass substrate handling
- Optimized platform design to enable high throughput
- Safety Glass handling design for critical glass thermal expansion and bending compensation
- Easy operation and maintenance for huge weight part

AKT has been successfully taken the key challenges in Gen.8.5 PECVD development. System performance will be discussed in the results section.

2. Results

AKT has successfully developed the world largest Gen 8.5 PECVD systems and shipped its 1st system in March 2007. The Fig. 1 shows the system picture of Gen 8.5, AKT-55K PECVD system. This system keeps cluster system architecture with maximum five process chambers.



Fig.1 Gen 8.5 AKT-55K PECVD

With a multi angle transfer chamber in the center, other functional chambers are attached around as load-lock, process chamber, heating chamber etc. refer to customer requirement.

With AKT-APX_LTM patented process chamber design, less than 8.0% deposition uniformity with 20mm edge exclusion has been achieved for 2200 mm x 2500 mm substrate size. Fig.3 is the AKT-50K process result presented as the thickness uniformity along glass diagonal directions. From Gen.5, Gen.6 and Gen.7 processes, the thickness uniformity has been successfully upgraded to Gen.8.5 as shown in Fig.2.

	Depo rate nm/min	R. I.	Stress E9D/cm ²	WER (6:1) nm/min	FTIR			
					NH (%)	SiH (%)	P.P. (cm ⁻¹)	W (cm ⁻¹)
gate-SiNx	70 ~ 200	1.89 ~ 1.91	C1 ~ C9	30 ~ 70	10 ~ 30	0.2 ~ 15	-	-
a-Si	10 ~ 200	-	C3 ~ C6	-	-	-	1995	95

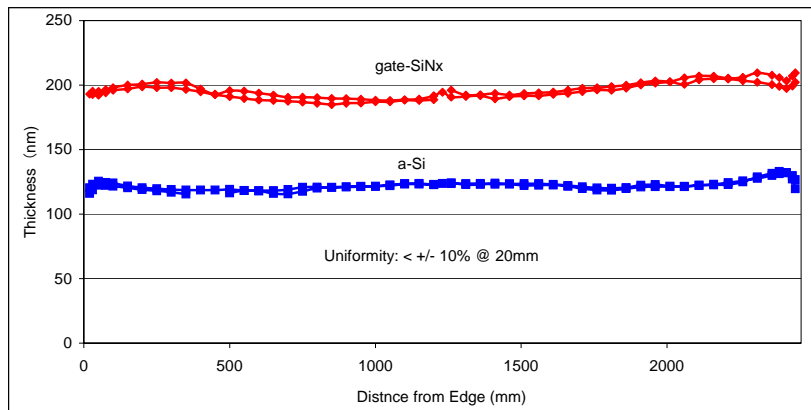


Fig.2 Gen 8/8.5 PECVD Process Data

3. Impact

In brief, expertise technology are required to meet the practical challenges of making very large-size vacuum processing equipment to satisfy the industry's high expectations for capital productivity improvement. With over ten years professional system development experience, AKT has successfully developed the key film process and will keep leading in the next generation system revolution.