SID-Bay Area Meeting:
Display Week 2013 Recap

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Outline – SID 2013 Recap

Introduction

SID 2013 Highlights

- Keynote Presentations
- Exhibition
- International Symposium

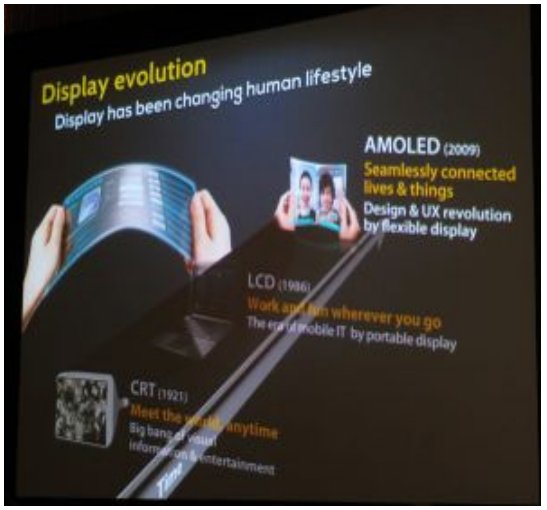
Display Industry Awards

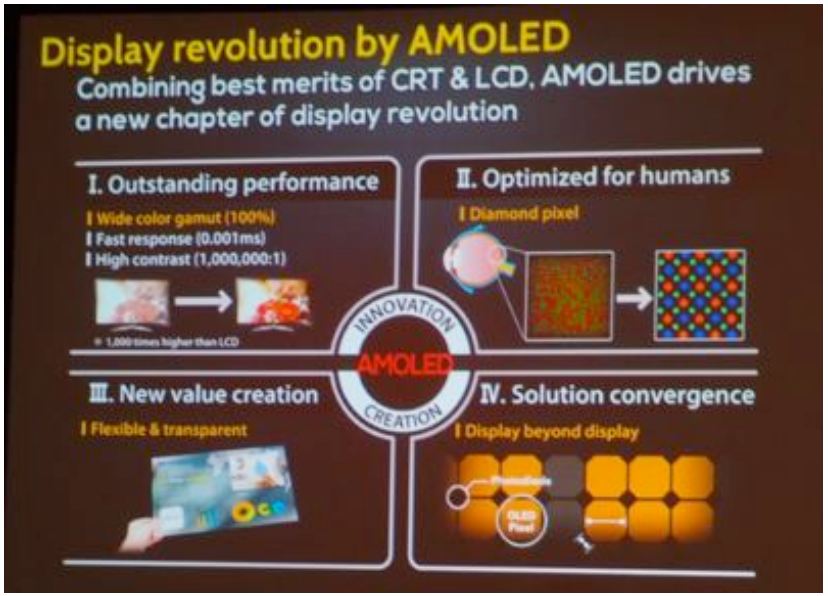
Question & Answer

SID 2013
Keynote Highlights

SID 2013 Keynote Highlights: Samsung CEO Presentation

- Dr. Kinam Kim, President and CEO of Samsung Display Co., Ltd. and head of the company's OLED business spoke of a “Display Evolution” being driven by OLED technology.
- He described OLED flexible displays as the coming next (3rd) generation of displays in a succession of display technologies.
- He outlined four (4) key attributes of AMOLED technology:
  1) Outstanding Performance
  2) Optimized for People
  3) New Value Creation
  4) Solution Convergence





SID 2013
Exhibition Highlights

SID 2013 Exhibition Highlights: Nine Major Themes (Excluding Touch Technology)

- UHD (4K) TV Products
- OLED TV Products
- Super High-Resolution Displays
- Widened Color Gamut LCD Technology
- Glasses-Free 3D Displays
- Next-Generation Flexible Displays
- Advanced Display Designs (Narrow Bezel, Transparent, etc.)
- Reduced Power Consumption
- Metal-Oxide TFT Array Technology

SID 2013 Exhibition Highlights: Overview of Value-Added Displays

Developer	Application	Description	TFT	Size & Format			PPI
Samsung	TV	4K AMLCD	a-Si	85"	UHD/4K	3840 x 2160	51 PPI
LG	TV	4K AMLCD	IGZO	84"	UHD/4K	3840 x 2160	52 PPI
LG	TV	AMOLED (conventional, flat)	IGZO	55"	FHD	1920 x 1080	40 PPI
LG	TV	AMOLED (curved, 3D)	IGZO	55"	FHD	1920 x 1080	40 PPI
LG	Smartphone	Hi-Res AMOLED (plastic)	LTPS	5"	FHD	1920 x1080	440 PPI
Samsung	Smartphone	Hi-Res AMOLED	LTPS	4.99"	FHD	1920 x 1080	441 PPI
JDI	Smartphone	Hi-Res AMLCD	LTPS	5.0"	FHD	1920 x 1080	440 PPI
Samsung	Tablet	Hi-Res AMLCD	a-Si	10.1"	WQXGA	2560 x 1600	298 PPI
LG	Tablet	Hi-Res AMLCD	IGZO	7"	FHD	1920 x 1080	314 PPI
Sharp	Tablet	Hi-Res AMLCD	IGZO	10.1”	WQXGA	2560 x 1600	298 PPI
Samsung	Notebook PC	Hi-Res AMLCD	a-SI	13.3"	WQXGA+	3200 x 1800	276 PPI
LG	Notebook PC	Hi-Res AMLCD	a-Si	14"	QHD	2560 x 1440	209 PPI
Sharp	Notebook PC	Hi-Res AMLCD	IGZO	15.6”	QHD	2560 x 1440	188 PPI
Sharp	Notebook PC	Hi-Res AMLCD	IGZO	13.3”	QHD	2560 x 1440	220 PPI
Sharp	Notebook PC	Hi-Res AMLCD	IGZO	11.6”	QHD	2560 x 1440	253 PPI
LG	Monitor	Hi-Res AMLCD	IGZO	23.8"	UHD/4K	3840 x 2160	185 PPI
LG	Smartphone	AMLCD (narrow bezel)	IGZO	5"	HD	720 x1280	293 PPI
LG	Notebook PC	AMLCD (narrow bezel)	a-Si	13.3"	FHD	1920 x 1080	165 PPI
LG	Mobile	AMLCD (narrow bezel)	IGZO	7"	HD	720 x1280	209 PPI
LG	Monitor	AMLCD (narrow bezel, 100% NTSC)	a-Si	23.8"	FHD	1920 x 1080	92 PPI
LG	Automotive	AMLCD (800 nit, 85% NTSC)	a-Si	12.3"	FHD	1920 x 1080	179 PPI
LG	Refrigerator	Transparent AMLCD	IGZO	47"	FHD	1920 x 1080	46 PPI

SID 2013 Exhibition Highlights: UHD LCD-TV Products

Samsung Display

85” UHD Panel
“Largest in Mass Production”

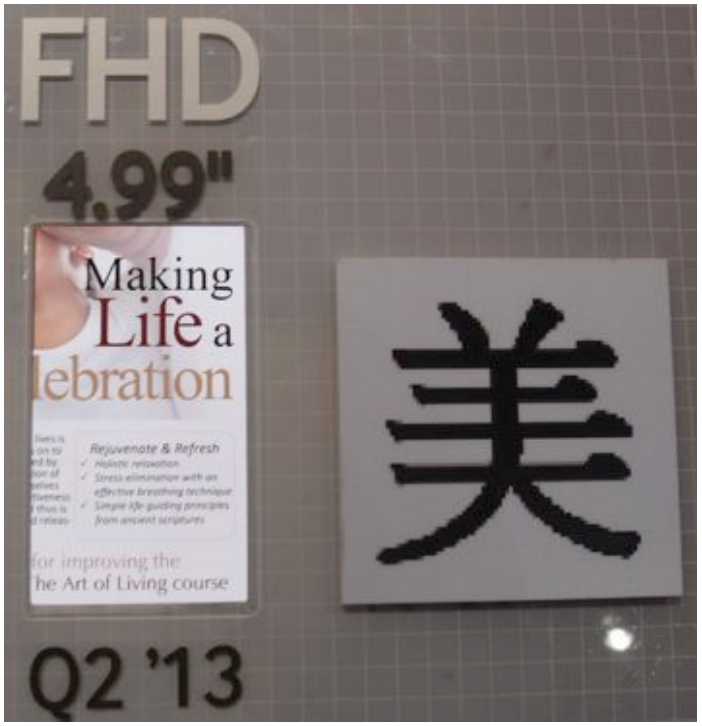
- 3840 x 2160 pixels, 500cd/m2,
- 5,000:1 contrast , 72% NTSC color
- Direct LED BLU, 240-zone local dimming
- 11.7mm narrow bezel

LG Electronics

84” UHD TV
Currently available in the market

- 3840 x 2160 pixels
- Edge-lit LED BLU
- Price: US$16,000

SID 2013 Exhibition Highlights: Samsung High-Resolution OLED Display



Samsung AMOLED
4.99” FHD OLED Display – 441ppi
Recently introduced in the Galaxy S4 Smartphone

Uses Super Slim On-Cell Touch to achieve a total display thickness of 1.82mm including cover window

Diamond Pixel
New OLED pixel layout
Better than Stripe layout for diagonal & curved characters

Green Phosphorescent EL Material
Provides for ~20% reduction in power consumption

SID 2013 Exhibition Highlights: LG Electronics OLED-TV Products

Conventional 55" OLED-TV
Model 55EM9700
Limited market release in early 2013

Metal Oxide (IGZO) TFT array
White-OLED with RGBW color filter
Full HD: 1920 x 1080 pixels
Price: ~US$10,000

Curved 55" 3D OLED-TV
Model 55EA9800
Limited release on June 10th, 2013

Same technology as conventional OLED panel
Uses Carbon Fiber-Reinforced Plastic frame
15 million won (~US$13,285)
4.3mm thick, 17kg weight

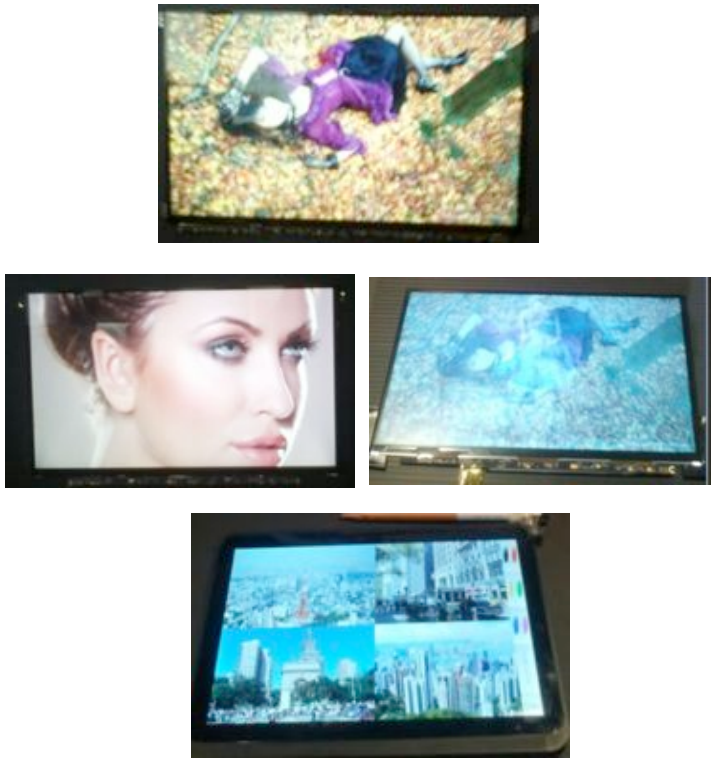
SID 2013 Exhibition Highlights: High-Resolution AMLCD Displays

Japan Display

LTPS-LCD
Smartphone Application
5” FHD LCD– 443ppi
0.95mm thick, 1mm bezel

Japan Display

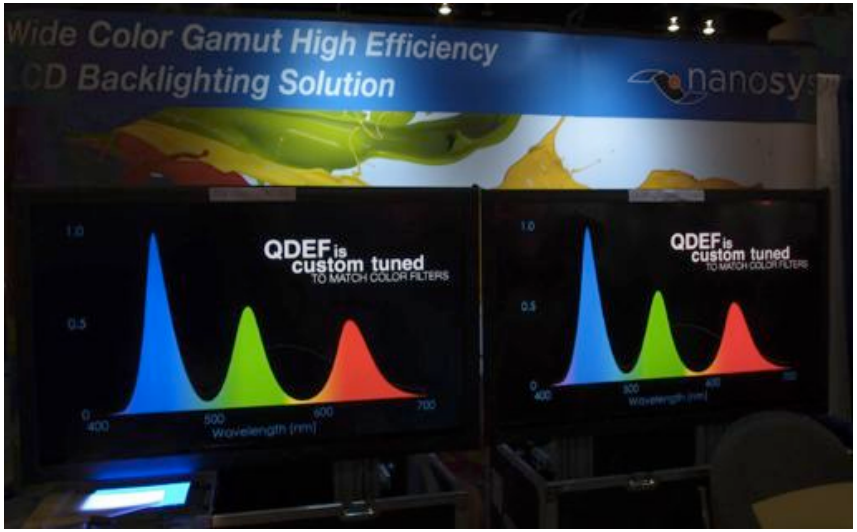
LTPS-LCD
Tablet or Auto Applications
7” FHD LCD– 314ppi



Sharp

IGZO-LCD
15.6” QHD, 13.3” WQHD,
11.6” WQHD, 10.1” WQXGA

SID 2013 Exhibition Highlights: Quantum Dot – Wide Color Gamut Technology



Nanosys

QDEF™ Technology
Films marketed through 3M
in Fall 2013

- Uses 3M's PET-based barrier film
- Nanosys & 3M will focus initially on mobile display products.
- In a typical LCD smartphone: 68.8% NTSC ⇒ 98.4% with QDEF™ vs. AMOLED: 103.9% NTSC

QD-Vision

Color IQ™ Component
Commercialization with Sony
from May 2013

- Five (5) high-end Sony TVs in the market: Three 2K TVs, Two 4K TVs (55", 65" models).
- Wide color gamut >100% NTSC (sRGB, Adobe)

SID 2013 Exhibition Highlights: Glasses-Free 3D Displays

Innolux

11.6” FHD
LTPS AAS Technology
Dual & Multi-View Modes

Japan Display

12.2” Automotive
720 HD (2D), 960x720 (3D)
Head Tracking Capability

LG Display

4.5” HD (720x1280)
Two Views, 2D-3D

LG Display

55” 3D LCD-TV
Fixed Lenticular Lens
Multi-View (20 Zones)
High Luminance
Wide Viewing Angle

SID 2013 Exhibition:
Flexible (Plastic) Display Demonstrators

LG Display

5" Plastic OLED Display
Smartphone Applications

- LTPS TFT array on polyimide substrate with thin-film encapsulation (similar to Samsung process)
- Production planned in late 2013

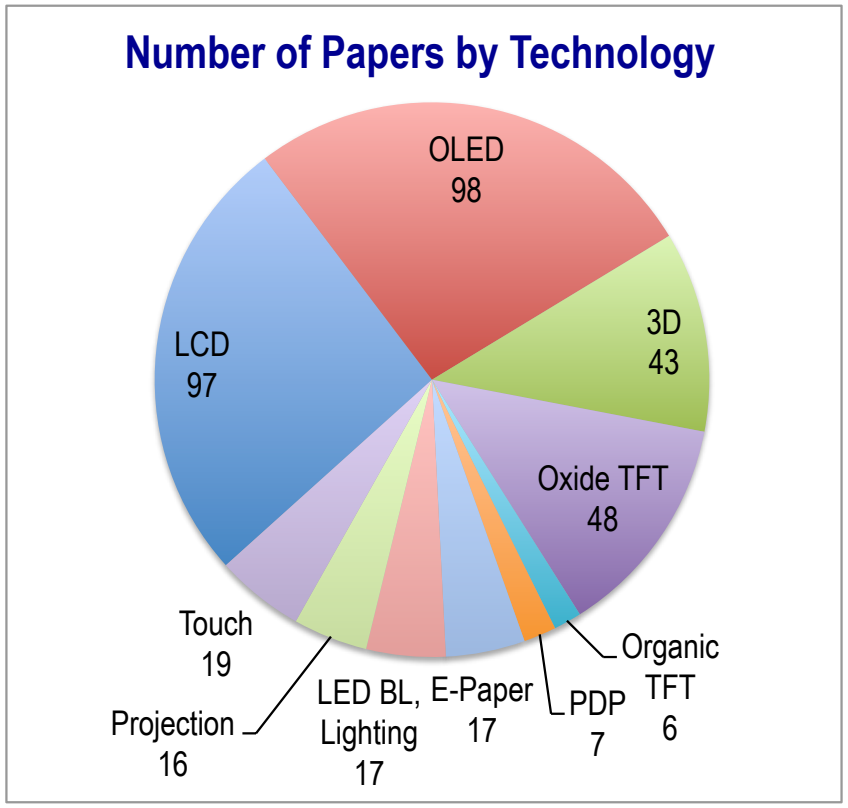
Sony & E Ink

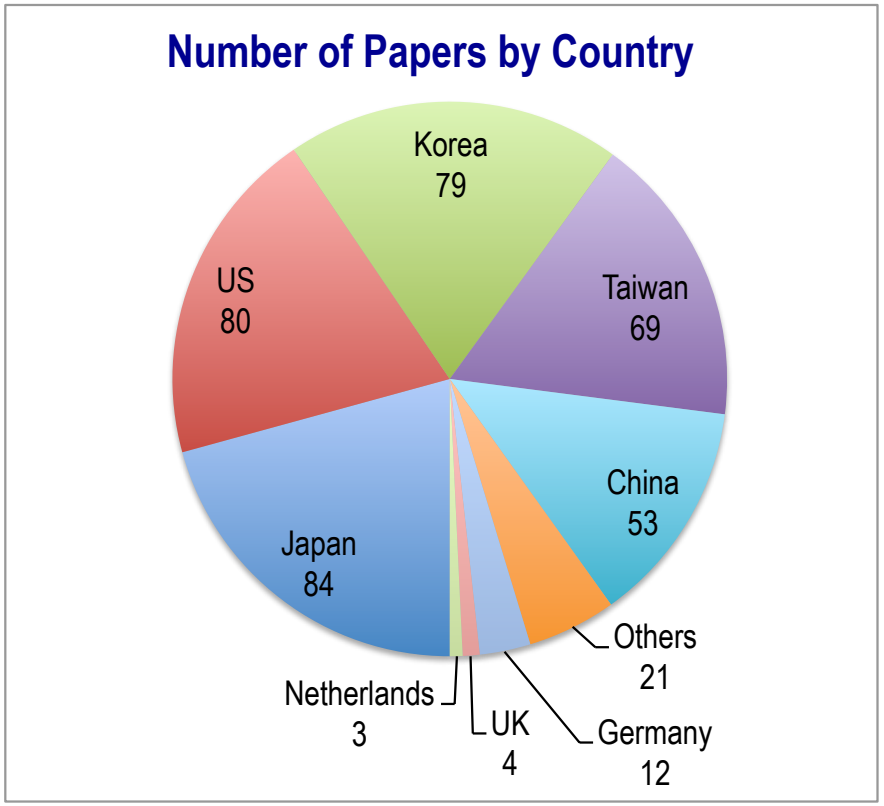
13.3" Digital Paper Device
Uses EM Induction Digitizer & Stylus

- All plastic display, including TFT array substrate
- 13.3” (A4 size), 6.8mm thick, 358 grams
- UXGA, 1200 x 1600 pixels with 16 levels grayscale
- Announced in May for end of 2013 release in Japan

SID 2013
International Symposium Highlights

SID 2013 International Symposium: Overview of Papers Presented

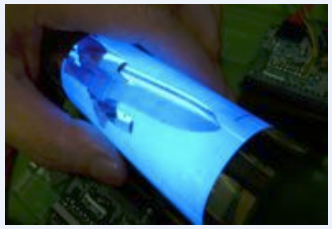
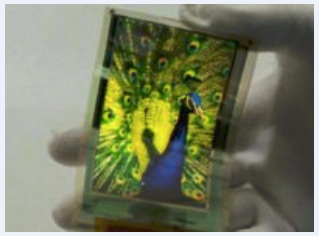
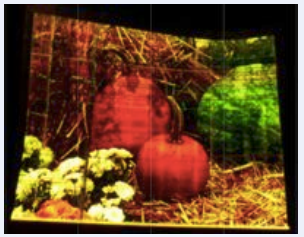




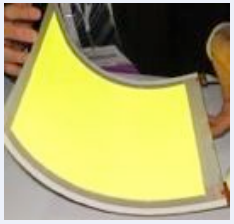
SID 2013 Symposium

254 Oral + 151 Poster = 405 Total Papers

SID 2013 International Symposium: Notable Flexible Display Papers

	Panasonic	Toshiba	SEL/Sharp	ASU FDC
Diagonal (in)	4”	10.2”	3.4”	14.7”
Pixel Format	224 x 224 x RGB	1920 x RGBW x1020	540 x RGBW x 940	960 x 720 x RGB
Resolution	80 ppi	223 ppi	326 ppi	81 ppi
OLED Device	Top- Emission	Bottom Emission	Top- Emission	Bottom Emission
OLED Technology	RGB	W-OLED + CF	W-OLED + CF	RGB
TFT Array Technology	a-IGZO	a-IGZO	CAAC-IGZO	a-IGZO
Substrate Material	PEN	PI	Transparent plastic	PEN
Bending Radius	R = 10mm	Not reported	R = 4mm	Not reported
Max. Process Temp	150ºC	Not reported	Not reported	200ºC
SID 2013 Session #	18.4L	70.1L	18.2	70.2L
SID Prototype ?	Yes	Yes	Yes	No
				

SID 2013 International Symposium: Notable OLED Lighting Papers

	Panasonic	SEL & Advanced Film Device	
Description	Highly Efficient OLED Lamp	Highly Efficient Flexible OLED Lamps	
Lamp Size (mm)	50 mm × 50 mm	56 mm× 42mm	360mm × 300mm
Luminous Efficiency	102 lm/W @ 3000cd/m^2 114 lm/W @ 1000cd/m^2	131 lm/W @ 1000cd/m^2	110 lm/W @ 1000cd/m^2
CIE Color Coordinates	(not reported)	0.49, 0.50	0.50, 0.50
Color Reproduction (CRI)	(not reported)	>90%	
Lifetime	~100K hours @ 1000cd/m^2	(not reported)	
Featured Technologies	• BLES（Built-up Light Extraction Substrate） • MLA (Micro-Lens Array)	• Exciplex (hole transport material • Three-color white: Orange-Green-Blue	
SID 2013 Session #	Session 66.2	Session 66.4	
SID Prototype?	Yes	Yes	Yes
			

SID 2013
Display Industry Awards

SID 2013 Display Industry Awards: Silver & Gold Winners

	SILVER AWARD	GOLD AWARD
Display Application Category	 The Nokia Lumia 920	 Apple's iPad with Retina Display
Display Component Category	 Sharp's Moth-Eye Technology	 QD Vision's Color IQ Component
Display Device Category	 CSOT 110-in. 4K × 2K 3-D LCD TV	 Sharp and SEL's IGZO LCD

Thank you!