Japan

OLED display

Market 2003

Sample Page

SRD JAPAN, INC.

Chapter2, Future OLED Market

2-1, Market Prospect

Table10: Prospect of the market scale of the OLED display
(based on the number/amount in 2001-2007 fiscal year)

(passive color)

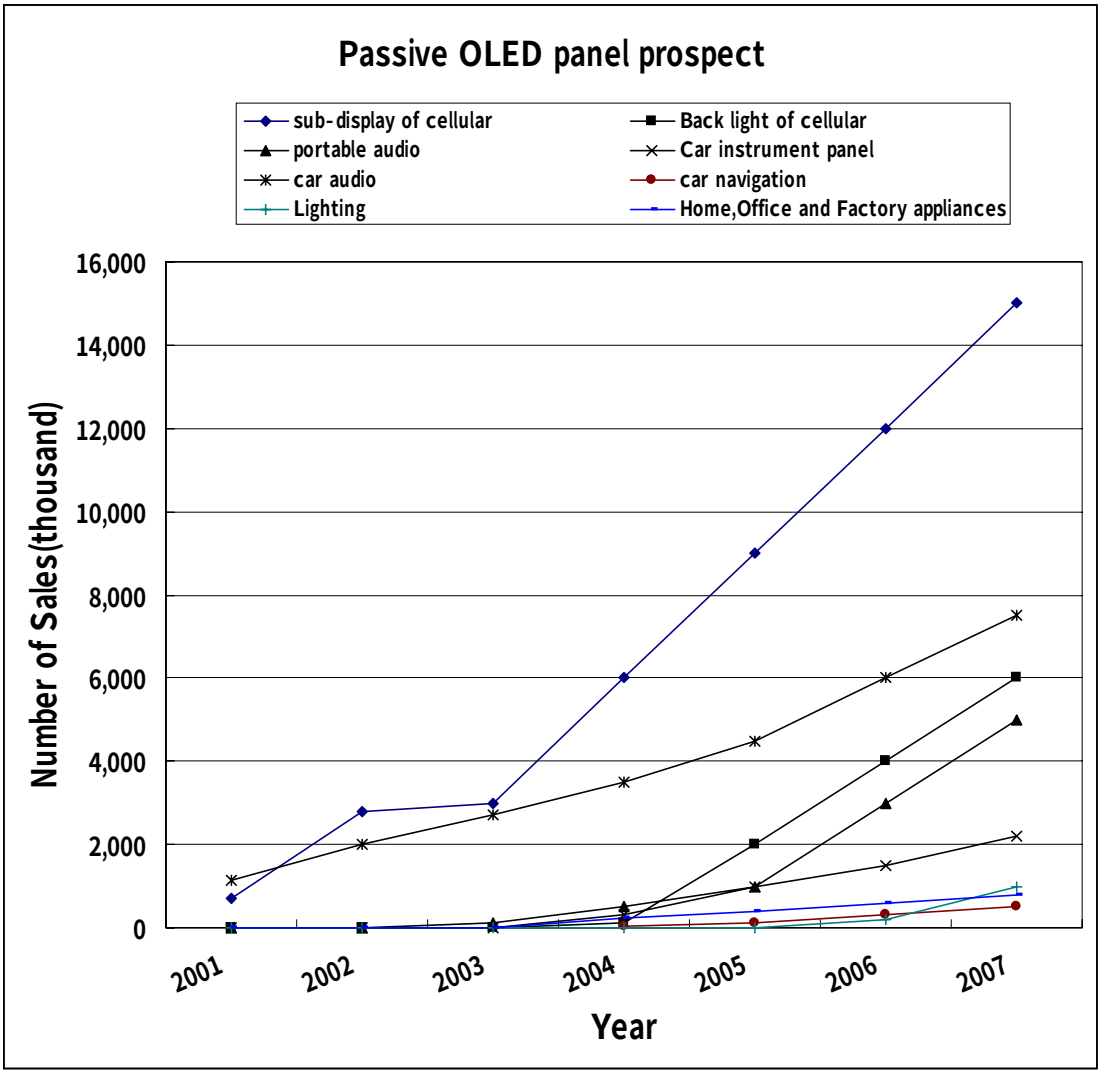
	2001	2002	2003	2004	2005	2006	2007	Size
sub-display of cellular	710	2,800	3,000	6,000	9,000	12,000	15,000	under 1.5inch
Back light of cellular	0	0	0	100	2,000	4,000	6,000	1.8～3 inch
portable audio	0	0	100	500	1,000	3,000	5,000	1～3 inch
Car instrument panel	0	0	10	300	1,000	1,500	2,200	1～10 inch
car audio	1,130	2,000	2,700	3,500	4,500	6,000	7,500	2～5 inch
car navigation				50	100	300	500	6～10 inch
Lighting	0	0	0	0	10	200	1,000	1～20 inch
Home,Office and Factory appliances	0	0	0	250	400	600	800	1～10 inch
Sub-Total (number;thousand)	1,840	4,800	5,810	10,700	18,010	27,600	38,000	
Sub-Total (amount;billion)	3.7	9.0	11.6	21.4	32.0	46.6	61.8	

(active full color)

	2001	2002	2003	2004	2005	2006	2007	Size
main-display of cellular	0	0	200	1,500	3,000	6,000	10,000	1.8～3 inch
PDA	0	0	0	50	200	300	500	4～7 inch
portable video	0	0	0	0	0	10	50	7～15 inch
Digital Camera /Video Camera	0	0	300	500	700	1,000	3,000	2～5 inch
TV/PC	0	0	0	0	0	100	1,000	over 10 inch
car audio	0	0	0	50	100	500	1,000	2～5 inch
Car navigation	0	0	0	0	0	50	100	6～10 inch
Sub-Total (number;thousand)	0	0	500	2,100	4,000	7,960	15,650	
Sub-Total (amount;billion)	0	0	3	11	20	80	313	

2-2, Passive OLED market

Fig7,Passive OLED prospect



It is mainly used for the sub-display of the cellular phone. The cellular phones with OLED sub-display, in which the numbers are lit up, came onto the market in 2002. But they have fallen in popularity because the STN that can display full color pictures entered the field.
Making the luminance higher will not enough for the OLED to come into wide use.

In 2004 the passive full color OLED is going to be brought into the market, which will make rapid progress in the field of the OLED.

The car audio is now applied only to the high-end head unit, and it is going to be applied to economy models. Some Korean manufactures such as Hyundai has made inquires about the car audio with OLED. There seems to be a great expect about OLED in Korean market.

As for the portable audio, it is expected that a new model that responses rapidly will be applied to the display of HDD audio, Minidisk, CD player and the IC audio.

Table15: Reference of each method to colorize the panel

Method	Productive technique	Merits	Demerits	Current situation
RGB method (Selective Deposition Method)	*construct dots by applying the material of OLED separately for each RGB. *The structure of the panel is plain.	*Make it possible to supply a picture display of high quality.	*Necessity to apply the three-color RGB separately with shadow mask. *Necessity to make the feature of the material uniform. *Lifetime of Red is short.	*Adopted by SANYO or SNMD, the company performing mass production.
CF (Color Filter Method of White EL)	*Make the white material of OLED vaporize, put it onto the base glass and colorize the panel using the color filter.	*No necessity to apply RGB separately. *Possibility to utilize the color filter of LCD.	*The feature of the panel is determined by the feature of the white material. *The delay of development of the white material of high purity. *Luminance Efficiency is poor.	*The white material with high brightness is developed by Taiho Industry in 2002. *Sanyo,TDK are developing.
CCM (Color Changing Method)	Make the blue material of OLED vaporize, put it onto the base glass and colorize the panel using the color-changing panel.	*No necessity to apply RGB separately. *The blue material has already developed.	*The delay of development of the color-changing panel. *The obscurity of the cost of the color-changing panel. *Many procedure	*Dainippon Ink and Idemitsu are co-operating in developing the color-changing panel. *Fuji Electric are developing.

SK Display, Idemitsu, TDK and Dainippon Ink have developed the active full color OLED panel for the TV with white color filter method. SANYO Electric is planning to bring it into market by 2005.

Chapter5, OLED panel manufacturers

5-1, SK Display

5-1-1, Active full-color OLED panels

SK Display is a consolidated company whose investors are Sanyo Electric and Kodak. The ratio of investment form Sanyo is 66% and 34% from Kodak.

SK Display was established in Gifu factory of Sanyo and develops OLED display. The low temperature poly-silicon TFT, which is essential for active driving, is purchased from Sanyo, and Kodak provides the material and technology for producing OLED Display sales will be carried out via both company respective sales channels.

Currently the panel with of the size of 2.2 inches and 2.16 inches as follows are the main product. Sanyo announced they would apply OLED panel of active full-color type with the cellular phone of au in 2003.

Table22, Specifications of Sanyo active matrix OLED

	ALE247 2.2 inch	ALE251 2.16 inch
Active area daiagonal(cm)	5.6	5.48
Number of dots(h*v)	176×RGB×220	512×218
Dot pitch(h*v)(mm)	0.066×0.198	0.084×0.151
Dot arrangement	Stripe	RGB Delta
Display colors	Full color	Full color
Active area dimensions(h*v)(mm)	34,848×43.56	43,806×32.918
Luminance(cd/㎡)	80	120
Driver IC	LC13502/LC41053	LC15005

The newest LCD has 40cd/㎡ luminance, which is half as high as that if the OLED. The contrast of the OLED is 3 times as high as the LCD. These features will attract users. The

5-2, Tohoku Pioneer

5-2-1, Passive mono-color OLED

Tohoku Pioneer has shipped the organic EL display for Motorola cellular phones as well as to the automotive AV made by Pioneer since 2000.

In 2002 its products were adopted by Fujitsu and LG Electron as the sub- display of cellular phones and as the automotive AV, adopted by KENWOOD, each of which sells well.

Photo; sub-display of Fujitsu docomo phone

Especially, they supply a lot of OLED for LG.

Photo:sub-display of LG cellular phone

The strong points of the mono color type are its reliability, high yield rate, the low electric consumption, and so on. The yield rate of the organic EL panel made by the company is 98%. The cellular phone by Fujitsu and LG Electron which is now on the market has some features such as the scroll of the literal information and three-colored display (blue, green and orange). Those features are completely different from the sub-display of LCD.

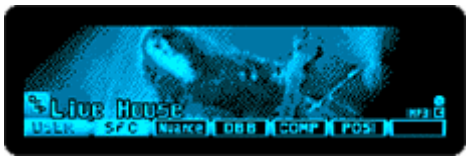


Photo: OLED display of Kenwood car audio head unit

The present luminance is controlled up to 50-60cd/㎡ in order to decrease the electric consumption. The active type is now under development because it consumes less electricity.

Table23: The main customers and features of product made by Tohoku Pioneer

application	maker	features of product
cellular phone	Fujitsu	passive 4 area colors brightness 60cd/㎡
	LG Electron	passive 3 area colors brightness 60cd/㎡
automotive audiovisual	KENWOOD	the number of the pixel 176×30 brightness 50cd/㎡ electric consumption 0.8W
	Pioneer	passive 4 area colors

5-2-2, Production trend

Tohoku Pioneer has the production base in Yonezawa city in Yamagata prefecture. They use the base glass whose size is 300×420mm. There are two production lines in the factory, and the productivity in full-operation is 500,000 per a month in terms of the size of 2.2 inches, and 1,200,000 per a month in terms of the sub-display.

The amount of their shipment in 2001 fiscal year based on the number, as to the area color panel for cellular phones, is 700,000 and 1,000,000 for that of the automotive AV: 1,700,000 in all.

The sum of the shipment is 32 million in 2001 fiscal year.

Tohoku Pioneer expects the sum will increase to 70 million in 2002 fiscal year considering the favorable sale of the area color OLED panel. It is more costly than STN-LCD, but considering its popularity among users, the capacity, the reliability and the distinction from other products, most makers seem not to worry about the cost.

5-7, TDK

The OLED, whose specification is shown in Table 29, has been adopted to the head units of the high-end car audio for Alpine since 2001. No progress can be seen other than this.

Tabale29, Specifications of TDK passive monocolor OLED(red,green,orange)

Size(mm)	170×39
thickness(mm)	9
Number of dots(h*v)	320×80
Dot pitch(h*v)(mm)	0.287×0.287
Contrast	100:1
Luminance(cd/㎡)	200
Temperature(℃)	-20～+60

The white color OLED, which is the strong point of TDK's product, had an agreement of cross license with Idemitsu. It can be applied as the base of the white OLED and the color filter method.

Table30, Specifications of TDK white monocolor OLED

Size(mm)	80×20
thickness(mm)	9
Number of dots(h*v)	256×64
Dot pitch(h*v)(mm)	0.28×0.27
Contrast	100:1
Luminance(cd/㎡)	50

The passive full color inorganic EL has been developed for industrial use. It has been licensed by iFire Technology. The advantageous point is its long lifetime.

Table31, Specifications of TDK passive matrix full color IEL(inorganic EL) for industrial application

Type	4.25inches
Size(mm)	128×108×1.9
Number of dots(h*v)	240×180
Dot pitch(h*v)(mm)	0.33×0.33
Color	1,120,000
View angle	>160
Luminance(cd/㎡)	200(white)
Lifetime to off	>50,000

(license from iFire Technology)

5-8, Fuji Electric

CCM gives the mono color luminescence and can make the organic film relatively easily. Fuji Electric has developed the OLED to the instrument panel together with Nippon Seiki.

The product has excellent specification; the luminance is 125cd/㎡ and the contrast is 500:1.

Table32, Specifications of Fuji Electric passive matrix full-color OLED(CCM)

Type	2.8inch
Size	57.6×43.2
Number of dots(h*v)	160×RGB×120
Dot pitch(h*v)(mm)	0.36×0.36(70ppi)
Duty Ratio	1/60
Luminance(cd/㎡)	125
Contrast ratio	500:1(in dark)
Display colors	262,144colors

Its lifetime is more than 15,000 hours by RGB.

Table33, Fuji electric OLED materials (Contrast ratio 105:1,100cd/㎡,1000lux)

color	CIE (X)	CIE (Y)	Efficiency (cd/A)	Half lifetime(hrs)
red	0.64	0.34	3	>15,000
green	0.23	0.66	8.6	>15,000
blue	0.13	0.13	2.2	>15,000

Chapter6, OLED material manufacturers

6-1, Idemitsu

6-1-1, Red OLED material

Idemistu has two businesses on OLED: developing the material and progressing the emission method.

First, the development of materials: they have succeeded to make the life of the red material longer, which is a problem about the low molecular OLED. The ability of the developed red material is 3.5cd/㎡ efficiency of the electrical current, 3.1lm/W luminous efficiency at 35cd/㎡, and the CIE are x=0.64 and y=0.36. It has got a longer life because of the aromatic ring dopant with a strong resistance to the electric current.

Second, the development of the CCM: the company is developing for CCM together with Dainippon Ink. The CCM is more advantageous than the RGB method both in the process and the cost. There is no problem about the blue material (6lm/W luminous efficiency) for utilization. They are developing CCM panel.

The CCM panel that is under development is able to deal with both the passive system and the active system. It is possible at the present time to produce the CCM panel of the size of up to 5 inches. The research and the development have been done at the facility oaf Dainippon Ink and they will be ready for mass production by 2003.

The problem about the base panel is that the contrast of the display is declined because of the fluorescence generated by the sunlight or room light. They have solved the problem by arranging the color filter between the CCM layer and the base glass.

The current problem is the inefficiency of color changing from blue light to red light. When the efficiency of electrical current of blue element is 10cd/A, the efficiency of red element becomes as little as 2.6cd/A. This color changing efficiency must be improved.

When the technology of the CCM is established, it will be advantageous in simplicity of the process, the enlargement of the display and the reduction of the cost.

Table37, Idemitsu OLED material

color	CIE (X)	CIE (Y)	Initial Luminance (nit)	Efficiency (cd/A)	Half lifetime(hrs)
blue	0.19	0.29	500	10	>10,000
deep blue	0.15	0.16	200	5.3	>10,000
yellow	0.46	0.52	1,000	9.3	>15,000
white	0.31	0.36	1,000	11	10,000
red orange	0.54	0.56	300	3.6	>10,000
orange	0.54	0.56	200	8	>10,000
red	0.64	0.36	500	3.5	>10,000