Yano Research Institute
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RESEARCH SUMMARY

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Noteworthy LED Applications: Key Research Findings 2009

Research Outline

Yano Research Institute has conducted a study on the noteworthy LED applications market as described below.

1. Research period: April to September 2009
2. Research targets: LED application manufacturers (ultra-large size display, LED indicator, automobile interior & exterior, projector, LCD backlight, medical equipment, bill recognition device), and LED manufacturer (21 firms in total)
3. Research methodologies: Face-to-face interviews with relevant personnel, supplemented by interviews via telephone and e-mail, and literature researches.

< What is LED application?>

LED application means a product or part/module which utilizes the light generated from LED chip (element) or module. Researched and analyzed in this research are the LED applied parts/products, of which the market is growing in recent years, or expected to grow. Especially, LED chips for 3 major application fields, ultra-large size display/LED indicator, automotive applications and LCD backlight are reviewed.

Key Findings

- **World LED chip market for ultra-large size displays and LED indicators is estimated to be 780 million chips in 2008 and 1,200 million chips in 2009.**

  Ultra-large size displays and LED indicators are generally installed in open air, at stadiums, amusement facilities and outside wall of commercial buildings, but are also increasingly installed inside the buildings and facilities. The world LED chip market for ultra-large size displays and LED indicators in 2008 is estimated to be 780 million chips (increased by 4.0% compared to the previous year). As the market is expected to grow with the realization of potential demands along with the economic recovery and increased sales of integrated systems such as digital signage, the world market size in 2015 is forecasted to be 1.2 billion chips (increase by 53.8% compared to 2008).

- **World LED chip market for automotive applications is estimated to be 3.66 billion chips in 2008 and 14 billion chips in 2015.**

  In addition to the existing applications for automobile exterior lighting such as tail lamps, the use of LED for interior lighting has been increasing in recent years. The world LED chip market for automotive applications in 2008 is estimated to be 3.66 billion chips (increased by 52.5% compared to the previous year). As the use of LED will be increased for the exterior lighting of luxury cars and hybrid vehicles, such as headlamp and brake lamp, as well as for interior lighting, the world LED chip market is expected to grow rapidly and reach to 14 billion chips in 2015 (increase by 282.5% compared to 2008).

- **World LED chip market for LCD backlight application is estimated to be 13.4 billion chips in 2008 and 36 billion chips in 2015.**

  Currently, LED backlight is used for all mobile phone displays (100%), and for more than 50% of the note PC displays. The world LED chip market for LCD backlight application is estimated to be 13.4 billion chips (increased by 27.6% compared to the previous year). In the future, the use of LED for note PC will reach to 100%, and the use of LED for LCD TV will increase as LED TV becomes popular, and the world LED chip market for LCD backlight application in 2015 is estimated to be 36 billion chips (increase by 168.7% compared to 2008).

Report format:

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Research Summary

1. LED chips for ultra-large size displays and LED indicators

1) Market overview

Ultra-large size displays in this research indicate full color, high resolution displays made with LED (mainly with LEDs placed with 10-20 mm distance, and the display size over 100 inches or so). The LED used in the ultra-large size display is RGB type in general (not in a part of such displays with monochrome type display), and several tens of thousands chips are used per display, depending on the size. Such displays are generally installed at stadiums, amusement facilities and outside walls of commercial buildings. The market size has been about 500 display systems or so per year, based on the installation. In recent years, as indoor installations are increasing, the market size is expanding and the number of LED chips used is increasing.

LED indicators are the displays with mono-color or color (partially full-color) LED, mainly used for character information display (also called as an information board or electric bulletin board), mainly installed at stadiums, public facilities such as government agency offices or airport. The LED indicators are generally with 2-3 colors. The colors used may vary depending on the product, such as blue, red or yellow. A few hundreds to thousands LED chips may be used depending on the display size and specifications.

Under these market conditions, the world LED chip market for ultra-large size displays and LED indicators in 2008 is estimated to be 780 million chips (increased by 4.0% compared to the previous year).

2) Market forecast

Although there is a large potential demands for ultra-large size displays and LED indicators, as these displays can be installed various places including financial institutions, government offices, large-scale commercial facilities, public facilities (railroad stations, airports), and retail stores, the market growth is expected to flatten due to the impacts of the global economic recession. However, the market is expected to grow in the long term, as the potential demands could be realized along with the economic recovery, and increased sales of integrated systems such as digital signage can be expected. Thus, the LED chip market is expected to expand as well.

Based on these market conditions, the world LED chip market for ultra-large size displays and LED indicators is estimated to be 1.2 billion chips in 2015 (increase by 53.8% compared to 2008).

2. LED chips for automobile interior and exterior applications

1) Market overview

Automotive LED applications can be divided into 2 categories, interior and exterior applications. In exterior application category, LED has already been adopted for tail lamps, while LED for interior lighting has been increasing in recent years. Triggered by the introduction of a hybrid vehicle with LED in interior and exterior applications in view of energy saving from a leading automaker, every automaker is beginning to promote the use of LED for their automobiles.

In interior application category, the adoption of LED is progressing in lighting applications such as interior lamps, in addition to car AV applications such as the backlight for car navigation display.

Under these market conditions, the world LED chip market for automotive applications in 2008 is estimated to be 3.66 billion chips (increased by 52.5% compared to the previous year).

2) Market forecast

The use of LED is expanding on the eco-cars, premium and hybrid vehicles, for exterior lighting such as headlamp and brake lamp, as well as for interior lighting applications. With the benefits of tax beaks on eco-cars, the sales of eco-cars, such as hybrid vehicles are doing well even in the current automobile recession, and this trend is expected to continue.

As a result, the world LED chip market for automotive application is expected to expand rapidly, and reach to 14 billion chips in 2015 (increase by 282.5% compared to 2008)

3. LED chips for LCD backlight application

1) Market overview

LED market for LCD backlight has been generated as the changeover from CCFL (cold cathode fluorescent lamp). Although LED is more expensive than CCFL, the adoption of LED has been increasing

in recent years, for reducing power consumption and thickness of the display, in addition to the improvement of color reproducibility. Already, LED backlight is used for all of the mobile phone displays and over 50% of the note PC displays.

The superior color reproducibility is achieved by placing RGB LED. There are 2 types of installation methods, direct backlight and edge light method. In case of direct backlight method, same as CCFL, the RGB (Red, Green, Blue) LED in several tens to several hundreds pieces are placed at the back of LCD panel, and a diffuser panel is placed in between, so that a surface light source can be generated for supplying uniform light to the liquid crystals. In case of edge light method, the light from the LED placed at the edges of the display is converted to surface light through a light guide panel and applied to the liquid crystals.

Although the edge light method used to be the mainstream, the adoption of direct backlight method has been increasing, because the gain and gamma characteristics of the LED can be individually adjusted for controlling the color temperature of the backlight itself by brightness gradation, and the color reproducibility and brightness can be improved.

Under these market conditions, the world LED chip market for LCD backlight application in 2008 is estimated to be 13.4 billion chips (increased by 27.6% compared to the previous year).

2) Market forecast

The ratio of LED adoption for note PC displays will reach to 100% and for LCD TV about 6% or so in 2015. In case of LCD TV, top ranking LCD TV manufacturers are focusing on the adoption of LED backlight, but the world TV market is still centered on CRT (Braun tube) based TV. Although the LCD TV market will rapidly expand with the demand shifting from CRT-based TV to LCD TV, the adoption of LED backlight may be postponed due to the price-priority nature of the world market. Thus the adoption of LED for LCD TV backlight is estimated to be about 6% or so even in 2015.

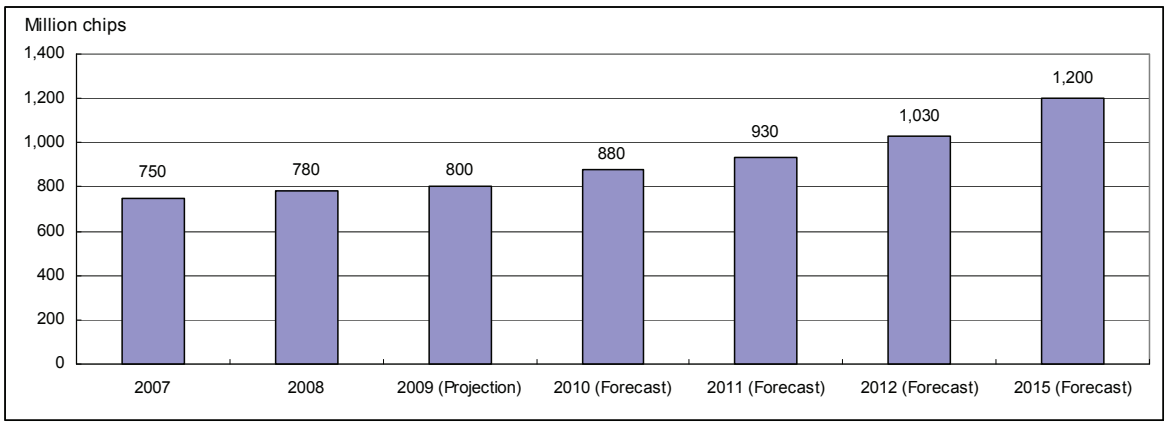
However, as the market for LCD backlight is relatively large compared to the other LED applications, with greater number of LED used in one product, LCD backlight is a major application. The LED backlight has become dominant for mobile phone displays, and will dominate the PC displays. In the future, the growth will move to LCD TV backlight, and will keep driving the growth the LED market.

Under these market conditions, the world LED market for LCD backlight application is estimated to reach 36 billion chips in 2015 (increase by 168.7% compared to 2008).

Table/Graph 1: LED Chips for Ultra-Large Size Displays & LED Indicators: Market Size Transition and Forecast

Quantity: Million chips, Year/year: %

	2007	2008	2009 (Projection)	2010 (Forecast)	2011 (Forecast)	2012 (Forecast)	2015 (Forecast)
LED chips for ultra-large size displays and LED indicators	750	780	800	880	930	1,030	1,200
Year/year	-	104.0	102.6	110.0	105.7	110.8	116.5



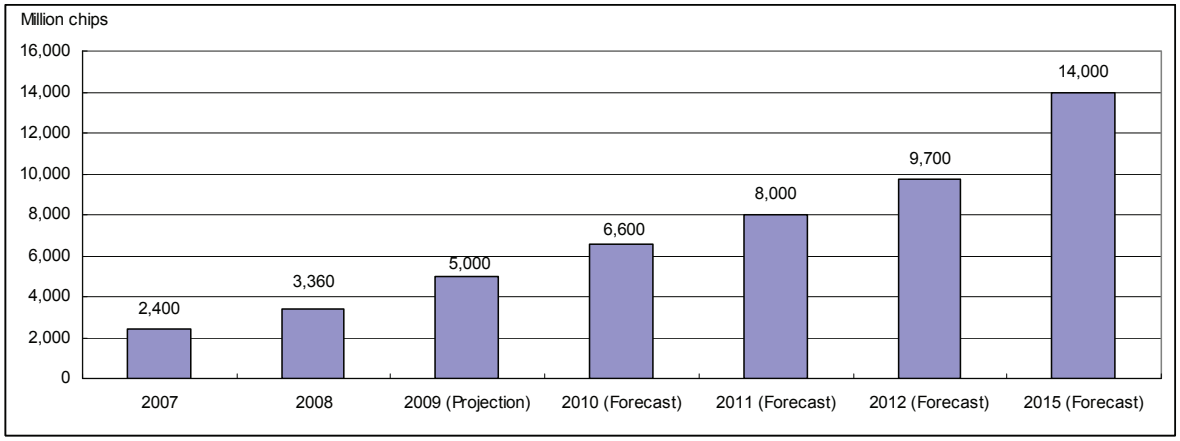
Estimated by Yano Research Institute

Note 1: Based on the shipment from the manufacturers
Note 2: Figures for 2007 and 2008 are the results, for 2009 projected and for 2010 and after forecasted.

Table/Graph 2: LED Chips for Automotive Applications (Interior/Exterior): Market Size Transition and Forecast

Quantity: Million chips, Year/year: %

	2007	2008	2009 (Projection)	2010 (Forecast)	2011 (Forecast)	2012 (Forecast)	2015 (Forecast)
LED chips for automotive applications (interior/exterior)	2,400	3,360	5,000	6,600	8,000	9,700	14,000
Year/year	-	152.5	136.6	132.0	121.2	121.3	144.3



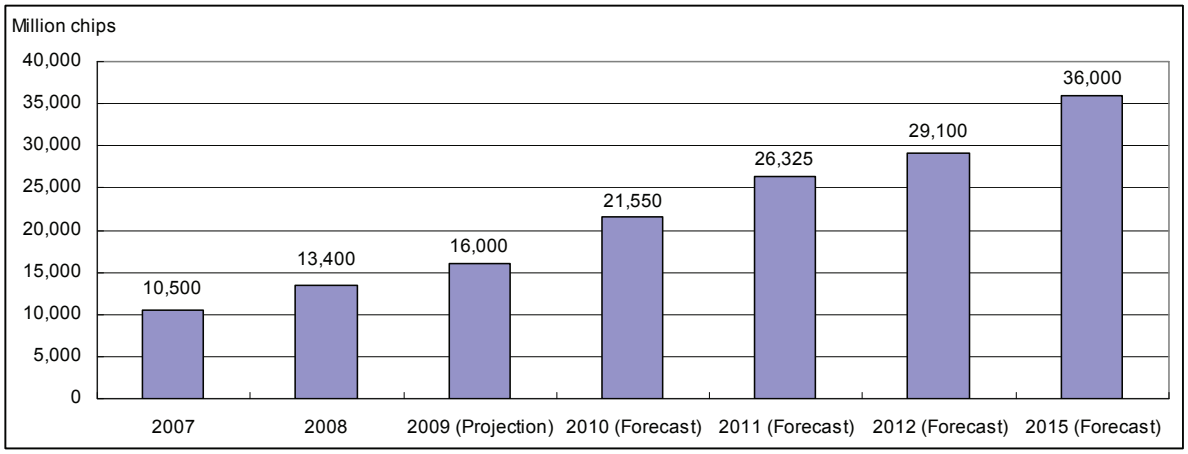
Estimated by Yano Research Institute

Note 3: Based on the shipment from the manufacturers
Note 4: Figures for 2007 and 2008 are the results, for 2009 projected and for 2010 and after forecasted.

Table/Graph 3: LED Chips for LCD Backlight Applications: Market Size Transition and Forecast

Quantity: Million chips, Year/year: %

	2007	2008	2009 (Projection)	2010 (Forecast)	2011 (Forecast)	2012 (Forecast)	2015 (Forecast)
LED chips for automotive applications (interior/exterior)	10,500	13,400	16,000	21,550	26,325	29,100	36,000
Year/year	-	127.6	119.4	134.7	122.2	110.5	123.7



Estimated by Yano Research Institute

Note 5: Based on the shipment from the manufacturers
Note 6: Figures for 2007 and 2008 are the results, for 2009 projected and for 2010 and after forecasted.