Displays

Overview of Korea's Industries 2012

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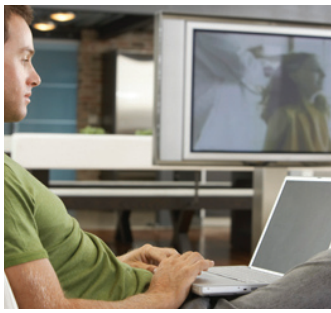

INVEST KOREA

1. Overall Status of the Display Industry

Flat-Panel Display (FPD) Market and Technologies

- The flat-panel display (FPD) market is growing based on the competitiveness of three major technologies: thin-film transistor-liquid crystal displays (TFT-LCD), plasma display panels (PDP) and organic light-emitting diodes (OLED).
- TFT-LCD has the largest market. The technology dominates the market, as it can be used in different types of applications, ranging from small devices including mobile phones to large appliances including televisions.
- PDP differs from LCD in that it does not need back light because it is self-luminous. Its use is limited to large applications such as televisions because the technology cannot be applied to small devices. It consumes more electricity than LCD.
- OLED is also self-luminous, and its use is limited to small devices such as mobile phones, as research is still underway to apply the technology to larger devices. OLED is lighter and consumes less electricity than LCD. It has great potential due to its simple structure and focus on materials, and it is praised as the foundation for flexible display, which is expected to lead the future.

Characteristics of the Industry

LCD: Capital-Intensive Mechanism Industry

- High-risk industry where failure for market estimation can lead to the elimination of a company and where a timely, large-scale investment is critical; industry where large companies that have the capacity to mobilize large capital are fully equipped with necessary parts and materials.

Investment Costs in Panel Line by Generation

Classification	5th	6th	7th	8th
Investment costs	KRW 1.1 trillion	KRW 1.5 trillion	KRW 2 trillion	KRW 2.5 trillion
Production capacity (input glass)	60,000/month	60,000/month	60,000/month	60,000/month
Optimal size	17"	32"	40"	46"
Size of major panels	1,100X1,300mm	1,500X1,850mm	1,870X2,200mm	2,200X2,500mm

Source: Displaybank

OLED is drawing attention as an alternative to the fundamental weaknesses of LCD

- (Definition) OLED is a next-generation display that uses organic compounds to emit light and has a more than 1,000 times faster reaction than LCD. According to how it works, it is divided into two categories: △Passive Matrix (PM) OLED that forms pixels by simply crossing positive and negative poles and △Active Matrix (AM) OLED that places TFT to be used as a switch on each pixel.
- (History) 1963 - First development of light-emitting display; 1987 - First development of OLED by Kodak; 1999 - Development of AM OLED by Sanyo-Kodak; 2000-2003 - OLED comes to market by Sony, Samsung, Pioneer; 2007 - Mass production of active matrix organic light emitting diode (AMOLED) panel by Samsung, launch of 11-inch television by Sony.

2. Characteristics of the Display Industry

Creation of Various Upstream / Downstream Industries

- The industry needs various parts and materials, creating high added values of downstream industries and many jobs.
- Diverse upstream markets - small- and mid-sized products including mobile phones, IT products (i.e. monitors and laptops), household appliances such as televisions, etc. (upstream → end products, downstream → parts, materials).

Display Supply Chain

Industrial Materials	Electronic Materials	Parts	Modules	Sets
Liquid crystal polymer, inorganic pigment, photosensitive polymer, glass tube, fluorescent substance, injection gas, resin, film material	Sheet (light guide plate/reflecting plate/diffusion plate), film (TAC, protective), photoresist, stripper, cleaner, electrode material, fluorescent substance, polarizing plate	Glass plate, liquid crystal, color filter, BLU (back light unit), driver, IC	LCD, PDP, OLED	TV, PC, mobile phone

Status of the Global Display Industry

Market Size and Major Corporate Players

- Market size: Japanese companies led initial technological development in the LCD upstream industry in the 1990s. But since 2000, Samsung and LG have made bold investments, and now the two companies are leading the global market.
  - Four northeastern countries (Korea, Taiwan, Japan, China) are actively nurturing the display industry as their national strategic industry, and they are the only countries producing LCD.
  - The LCD upstream market stood at USD 88.7 billion in 2008 and has decreased to USD 71.7 billion due to the global recession. But with the market bouncing back, it is expected to grow to the 2008 level by 2014.
- Major manufacturers by country: Korea (Samsung, LG Display), Japan (Sharp, IPS Alpha, TMD, NEC, Hitachi, Fujitsu, Epson, Sony), China (BOE-OT, SVA-NEC, IVO, Century, Tianma), Taiwan (AUO, CMO, CPT, Hannstar Innolux, Prime View).

Growth Potential of Each Country

Size of the upstream display market by country

Classification	Korea	Taiwan	Japan	China
Market size (USD million)	36,217	33,053	17,210	2,411
Market share	41%	37%	19%	3%

Status of Korea's Display Industry

- Korea's LCD modules: 35-40 trillion KRW of annual revenues.
- World's top 2 global LCD manufacturers (Samsung Electronics, LG Display).
- World's top 2 global LCD TV brands (Samsung Electronics, LG Display).

LCD Industry Clusters

- Five clusters (Paju, Giheung, Tangjeong, Cheonan, Gumi) have been established, and among them, Paju (LG Display) and Tangjeong (Samsung) are equipped with the newest facilities.

Comparison of the Top 2 Clusters

Classification		Paju	Tangjeong
Distance to major facilities or places	Incheon International Airport	164km	50km
	Ports	30km (Pyeongtaek, Dangjin)	50km (Incheon)
	Seoul	85km	35km
	Seoul Station	34 minutes (KTX), 90 minutes (automobiles)	60 minutes (automobiles, railroads)
Water supply		Daecheong Dam	Paldang Dam
Cities in the vicinity		Cheonan, Asan	Ilsan
Institutions for higher education		Cheonan (8), Asan (4)	
Strengths		Located at the center of Korea	Adjacent to Seoul
Weaknesses		Distance from Seoul	Adjacent to the military demarcation line (psychological issues).

Types and Industry Status of Core Electronic Materials

Types of core electronic materials

Materials	Details
Glass	Glass Substrate
LC	Liquid Crystal
Wet Chemical	Developer, Echant, Stripper, Thinner
Target	ITO, AL, Mo
Organic Chemical	Photo/Color Resist, Overcoat, Photo Spacer, PI, BM
Gas	Cleaning/Processing Gas
Polarizer Films	Compensation, Protection, Release, TAC, PVA
Blu Films	Diffusion, Prism, Reflection, Reflective Polarizer
OLED Used Organic Material	HIL/HTL EML/ETL

Status of the core electronic parts/materials industry

Glass

Classification	Remarks
Status of the domestic industry	- Samsung Corning Precision Material (SCP) has melting furnaces in Korea and is supplying Samsung and LG Display (LGD) with glass. - NEG founded PEG, a JV with LGD, in Paju. - AGC has lines for front-end/back-end processes in Gumi. - NHT changed its name to AvanStrate INC in 2008, as Carlyle acquired its shares. - After Schott withdrew its business in Korea, LG Chemicals purchased its assembly lines and technologies.
Market size	Over USD 4.9 billion per year, four suppliers.
Growth rate	Average annual growth rate of 5.3% expected by 2014.
Suppliers	All of the global companies (SCP, NEG, AGC, ASI) have a presence in Korea.
Ratio of imports	Over 70% is locally produced and less than 30% is imported.
Entry barrier	Schott attempted to enter the market but failed. Demand is high due to lack of supply, but the entry barrier is high.
Market penetration by foreign companies	The four suppliers have already secured production bases in Korea.

Liquid Crystal (LC)

Classification	Remarks
Status of the domestic industry	Companies including Merck and BASF from Germany and Chisso and Dainippon Ink Corp (DIC) from Japan are competing, but Merck dominates more than half of the global market.
Market size	Over USD 500 million per year.
Growth rate	Average annual growth rate of 12.2% expected by 2014.
Suppliers	Merck (factories in Pyeongtaek), Chisso, DIC.
Ratio of imports	Entirely importing raw materials (Merck: post-processing at Pyeongtaek. Chisso, DIC: entirely importing).
Entry barriers	Merck, Chisso and DIC monopolize the global market. High-entry barriers in technologies discourage new companies from joining the industry.
Market penetration by foreign companies	- Little need to localize the production of raw materials for LC. - No difficulty importing raw materials from Germany and Japan.

Wet Chemical

Classification	Remarks
Status of the domestic industry	Local players have large market shares and advanced technologies, so foreign companies have no motivation to enter the Korean market.
Market size	Over USD 700 million, high ratio of etchant and stripper markets.
Growth rate	Average annual growth rate of 8.8% expected by 2014.
Suppliers	Over 10 suppliers.
Ratio of imports	No imports at all.
Entry barriers	Active localization encourages competition among local companies.
Market penetration by foreign companies	Most global companies have already secured production bases in Korea.

Target

Classification	Remarks
Status of the domestic industry	Metal target factories are located near metal mines, and only post-processing factories enter the overseas market.
Market size	Over USD 500 million per year.
Growth rate	Average annual growth rate of 13.5% expected by 2014.
Suppliers	Less than 10 suppliers.
Ratio of imports	About half is imported.
Entry barriers	Metal materials for electrodes are monopolized by companies owning mines. The number of suppliers is not large, but high entry barriers exist.
Market penetration by foreign companies	- Little need to localize the production of raw materials for targets. - Some companies have secured production bases in Korea for post-processing. There is a possibility of penetrating the Korean market for part of post-processing.
Major products	- ITO Target (domestic market dominated by SCP, Heesung Metal and Nikko), Al Target (Japan's Kobelco and Korea's Dongwoo Fine-chem share the domestic market and Kobelco is monopolizing the global market), MO Target (Plansee's share is over half and the rest is dominated by Hitachi Metal, Ulvac and Mitsui Mining).

Polarizer Films

Classification	Remarks
Status of the domestic industry	As it is a proprietary item, there is concern about technology leaks. Production facilities in Japan are enough to meet demand.
Market size	Over USD 1.9 billion per year.
Growth rate	Average annual growth rate of 7.8% expected by 2014.
Suppliers	About 10 suppliers (Fuji Film, Konica Minolta, Kuraray, Nihon Gosei, Sekisui Chemical, Fujimori Kogyo, Sun-A Kaken, Osung LST, Mitsubishi Plastics).
Ratio of imports	In general, the polarizer film industry is slow in localization. TACPVA and compensation films are produced in Japan, and protective films and release films are being localized by LG Chem, Osung LST and Toray Advanced Materials.
Entry barriers	Customers of TAC, PVA and compensations have a high need for localization, but Japanese companies have little need for localization. Korean companies are actively localizing protective films and release films.
Market penetration by foreign companies	Foreign companies with TAC and PVA are less willing to penetrate the Korean market due partly to technology protection issues. Korean players are expanding market shares of protective films and release films.
Major products	The TAC film market is exclusively dominated by Fuji Film and Konica Minolta, because of issues such as raw material supply, limited demand and high technological barriers.

Organic chemical

Classification	Remarks
Status of the domestic industry	As local companies continuously raise their technology levels, the localization rate rises.
Market size	Over USD 1.1 billion per year.
Growth rate	Average annual growth rate of 15.6% expected by 2014.
Suppliers	About 10 suppliers (Korean companies: LG Chem, Cheil Industries, Kolon, Dongjin Semichem; foreign companies: JSR, Chisso, TOK, AZEM).
Ratio of imports	70% is locally produced and 30% is imported.
Entry barriers	A large number of local and global companies are competing in the domestic market, but continuous technological development is still needed. So companies with proprietary technologies can enter the market.
Market penetration by foreign companies	Most global companies have secured production bases in Korea. Some products are imported, but cost pressure is not strong.
Major products	- Photo Resist: The domestic market is led by Dongjin Semichem, and Zeon, AZEM, Cotem and Dongwoo Fine-Chem are major suppliers. - Color Resist: Thanks to localization, Cheil Industries and LG Chem are major suppliers and the rest is covered by JSR and Sumitomo. - Resin BM: Cheil Industries is exclusively supplying Samsung Electronics with materials, and LG Display's suppliers are Japan's TOK and Korea's Soulbrain. - Overcoat: The domestic market is dominated by Kolon and LG Chem (Korea) and JSR and Chisso (Japan). - Photo Spacer: Japan's JSR has the largest share in the Korean market, and local companies including Dongjin Semichem, LG Chem and Exax are competing. - PI: Over 80% of polyimide, which is a raw material for alignment layers, is provided by Japan's JSR and Nissan. Local company Cheil Industries is also doing business, but Japanese countries have long dominated the market.

Gas

Classification	Remarks
Status of the domestic industry	Most foreign companies with competitive gas business have secured production bases in Korea.
Market size	More than USD 300 million per year.
Growth rate	Average annual growth rate of 11.3% expected by 2014.
Suppliers	About 10 suppliers (local companies such as Sodiff and Daesung Industrial Gases, and foreign companies including Air Products and Praxair).
Ratio of imports	20-30% (70-80% is locally produced.)
Entry barriers	Global gas companies have already entered the Korean market, and OCI Materials and Daesung Industrial Gases are continuously expanding their presence.
Market penetration by foreign companies	Some of the companies that recently entered the Korean market have not founded production bases.
Major products	- Cleaning Gas: Air Products and OCI Materials are the two strongest players in the Korean cleaning gas market, and Kanto Denka, Foosung and Hyosung also have high market shares. - Processing Gas: The domestic market is dominated by Air Products, Air Liquide, OCI Materials, Daesung Industrial Gases, Showa Denko and Praxair.

Back Light Unit (BLU) Plastic

Classification	Remarks
Status of the domestic industry	Korean companies have advanced technologies for films and materials used for BLU. It is used as material for module processing, which is a part of the post-processing of LCD manufacturing. Module processing is being transferred to China.
Market size	Over USD 200 million per year.
Growth rate	Average annual growth rate of 11.3% expected by 2014.
Suppliers	3
Ratio of imports	Imports account for 30%. Japanese companies have been competitive in BLU plastics, but the localization level is high.
Entry barriers	The diffusion plate sector is highly localized and competitive. Light guide plates are usually manufactured at factories in Japan.
Market penetration by foreign companies	BLU attachment processes are being transferred to countries like China, so Korea is not appropriate for capacity building and localization.
Major products	- LGP: PMMA, used for light guide plates, is a traditional chemical material. It requires high initial capital and has high technological barriers. Japanese companies are providing Korean companies with it, except for LG MMA, a JV with Nippon Catalyst. As production bases for BLU are transferring to China and products of Coretronic and Radiant (Taiwan) are becoming more popular, the demand for products of Chi Mei (Taiwan) is on the rise. - Diffusion plate: The diffusion plate market started its growth along with the spread of LCD TVs. Teijin and Asahi Kasei dominated the market at first, but Korean companies including Cheil Industries, Dongwoo Fine-Chem, Kolon and Heesung Chemical are rapidly replacing the Japanese players.

Back Light Unit (BLU) Films

Classification	Remarks
Status of the domestic industry	Korean companies have advanced technologies for films and materials used in BLU. BLU is a material for module processing, which is part of the post-processing of LCD manufacturing. Module processing is being transferred to China.
Market size	Over USD 1 billion per year
Growth rate	Average annual growth rate of 2.1% expected by 2014
Suppliers	Over 10 suppliers
Ratio of imports	The BLU film industry is being rapidly localized. Reflection films are exclusively provided by two Japanese companies and only post-processing is carried out in Korea. Reflective polarizers are monopolized by 3M.
Entry barriers	There is little need for newcomers in the industry, except for reflective polarizers. As 3M has many patents in the field, Korean companies are localizing the production of reflective polarizers with technologies that do not infringe on 3M's patents.
Market penetration by foreign companies	The market for diffusion films and prism films has been saturated due to localization, so the market potential is limited.
Major products	- Diffusion film: The first BLU film to realize localization. SKC-Haas, Shinwha Intertek, Sangbo, Kolon and Toray Advanced Materials dominate the market, out-competing Japanese companies. - Reflection film: Toray and Teijin Dupont Film (Japan) dominate the market. Market entry is not easy, as it is a low-price product and Toray has a patent for technologies to manufacture it. - Prism film: 3M dominated the market from the early stage of LCD until 2005 as an industry pioneer based on its patent for prism shapes and their combinations that increase luminance. Since 2005, companies from Korea, Japan and Taiwan have rapidly penetrated the market by developing technologies to form prism patterns and securing manufacturers. - Reflective polarizer: 3M holds a monopoly in the reflective polarizer market with its technologies and patents. Mirae Nano Tech, Shinwha Intertek, LMS and Woongjin Chemical (Korea) are developing alternative technologies.

OLED Used Organic Material

Classification	Remarks
Status of the domestic industry	Electronic materials for OLED are similar to TFT-LCD. Organic materials forming emission layers are expected to grow with the OLED market.
Market size	The domestic organic materials market in 2009 stood at USD 80 million, but it is showing rapid growth, expected to grow to USD 160 million in 2011 and USD 1.47 billion in 2014.
Growth rate	Average annual growth rate of more than 70% expected by 2014 (rapid growth expected as new markets are created).
Suppliers	Over 10 suppliers.
Ratio of imports	Dependence on foreign companies was high in the early stages, but thanks to localization, imports currently account for a small part.
Entry barriers	Global players show strong performance, but partnerships are strong as materials companies and front-end businesses usually pursue joint development. Companies with proprietary technologies can enter the market.
Market penetration by foreign companies	Not many foreign companies are in the Korean market due to low demand and high prices.
Major products	- HIL/HTL: LG Chem and LUDIS (Korea) are major suppliers. Hodogaya (Japan) supplies to Korean companies, but the supply is decreasing. - EML/ETL: Major suppliers of EML in Korea include Gracel, SFC, Doosan Electro-Materials and BG; Idemitsu (Japan) has also penetrated the Korean market, but its supply is decreasing.

3. Investment by Foreign Companies

Company	Location	Investment type	Products	Remarks
Samsung Corning Precision Materials	Cheonan, Gumi	Joint Venture (JV)	Glass, ITO, Target	JV of Corning (U.S.), Bokwang, Samsung Corning
Nippon Electric Glass (NEG)	Paju	JV	Glass	Established a JV (PEG) with LG display
Asahi Glass Corp (AGC)	Gumi	Direct Investment (DI)	Glass	
AvanStrate Inc (ASI)	Pyeongtaek	DI	Glass	Former NHT
Merck	Pyeongtaek	DI	LC	
Chisso	Pyeongtaek	DI	LC, Overcoat	Chisso Korea
Dongwoo Fine-Chem	Pyeongtaek, Iksan	DI	Etchant, Stripper, Photo Resist	Japan's Sumitomo Chemical owns 100% of shares
AZEM	Anseong	DI	Developer, Thinner, Photo Resist	AZEM Korea
Hantok Chemicals	Ulsan	JV	Developer	JV of Japan's Tokuyama and Samsung Fine Chemicals
Nikko	Pyeongtaek	DI	ITO Target	Nikko Materials Korea
Mitsui Mining	Pyeongtaek	DI	Al Target	Mitsui Metal Korea
Ulvac Materials	Pyeongtaek	DI	Mo Target	Ulvac Korea
TOK	Paju	JV	Resin BM	JV with Cotem
Nissan Chemical	Pyeongtaek	DI	Pi	NCK
Air Products (AP)	Gumi, Ulsan	DI	Gas	Air Products Korea
Air Liquide	Yeosu	DI	Gas	Air Liquide Korea
Fuji Film	Seoul	DI	TAC	Fuji Film Electronic Materials Korea
Toray Advanced Materials	Gumi	JV	Diffusion Film	JV of Japan's Toray and Korea's Saehan
3M	Naju	DI	Prism Film	Post-processing
Teijin Dupont	Seoul	DI	Reflection Film	Dupont
LG MMA	Yeocheon	JV	PMMA	JV of LG, Nippon Catalyst, Sumitomo Chemical
Mitsubishi Rayon	Daesan	JV	PMMA	JV with Daesan MMA
Bayer Sheet Korea	Gimhae	DI	Diffusion Plate	Acquisition of Sewon Precision Industry

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