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# Outline of IT-related Products Segment

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**Toray Industries, Inc.**

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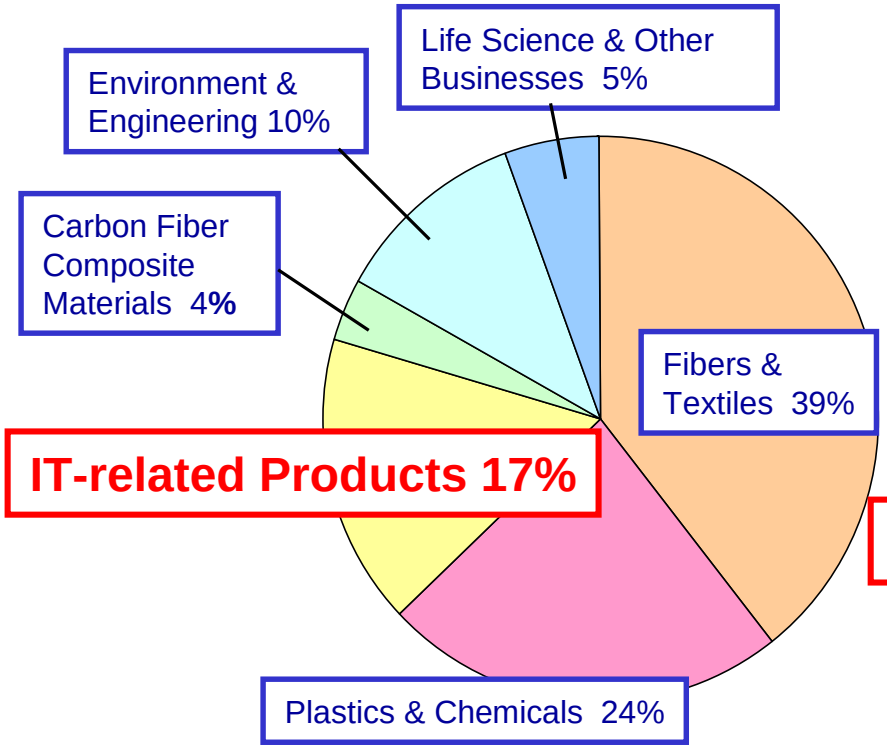
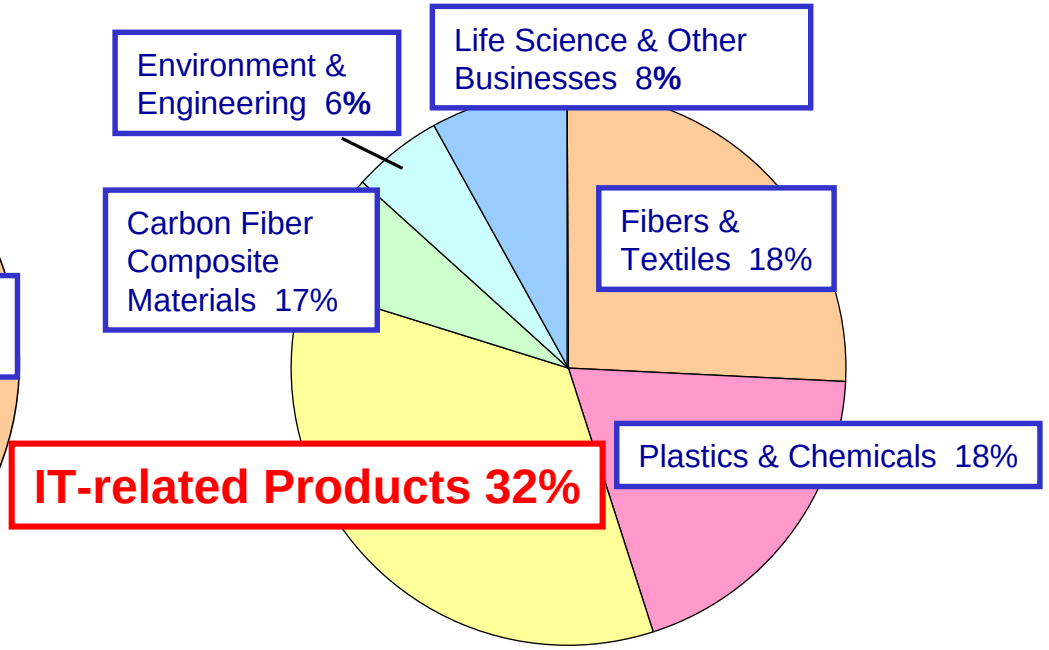
# I. Outline of IT-related Products Segment

# Positioning of IT-related Products Segment in Toray Group

**Consolidated Net Sales :**
**¥ 1,546.5 billion**
**(FY Mar/07)**

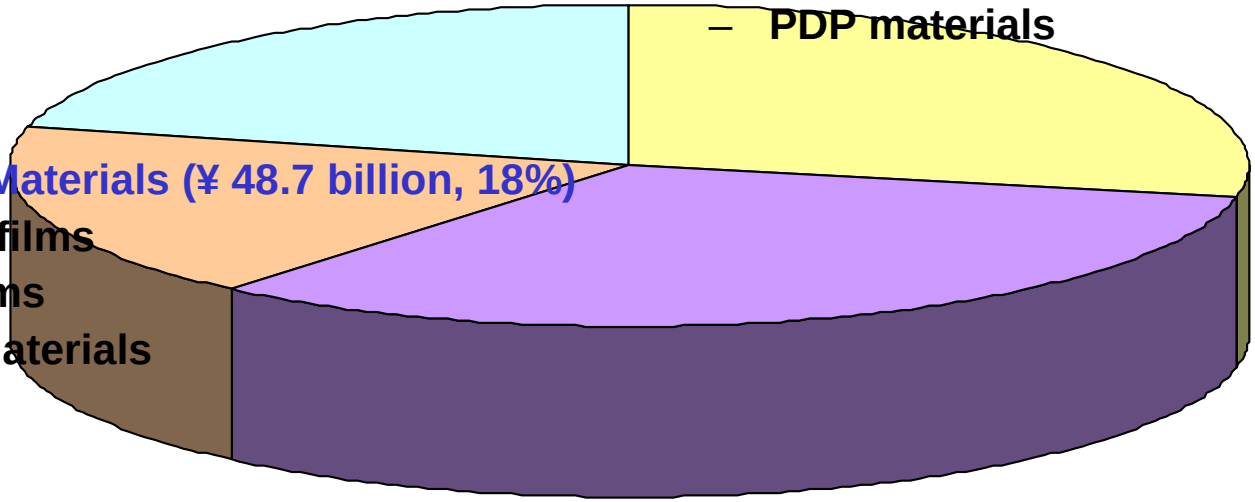



**Consolidated Operating Income :**
**¥ 102.4 billion**
**(FY Mar/07)**



# Product Lines of IT-related Products Segment

- **Equipments, others (¥ 54.3 billion, 21%)**
  - LCD color filter production equipment
  - semiconductor bonding equipment
- **Display Materials (¥ 74.1 billion, 28%)**
  - LCD color filters
  - opitcal film, paste materials
  - PDP materials
- **Data Storage Materials (¥ 48.7 billion, 18%)**
  - polyester films
  - aramid films
  - printing materials



**IT-related Products Segment**
**Net Sales : ¥ 263.8 billion**
**Operating Income : ¥ 33.5 billion**
**(FY Mar/07)**

- **Electronic Component, Semiconductor, Circuit Materials (¥ 86.7 billion, 33%)**
  - semiconductor-related materials
  - flexible printed circuit board materials
  - release films

# Major IT-related Products

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Adhesive Tape for TAB (ICC)

Two-layer Copper Clad Laminate Film for COF "Metaloyal"

FPC Copper Clad Laminate Film (KCC)

Adhesive Tape for Semiconductors (TSA)

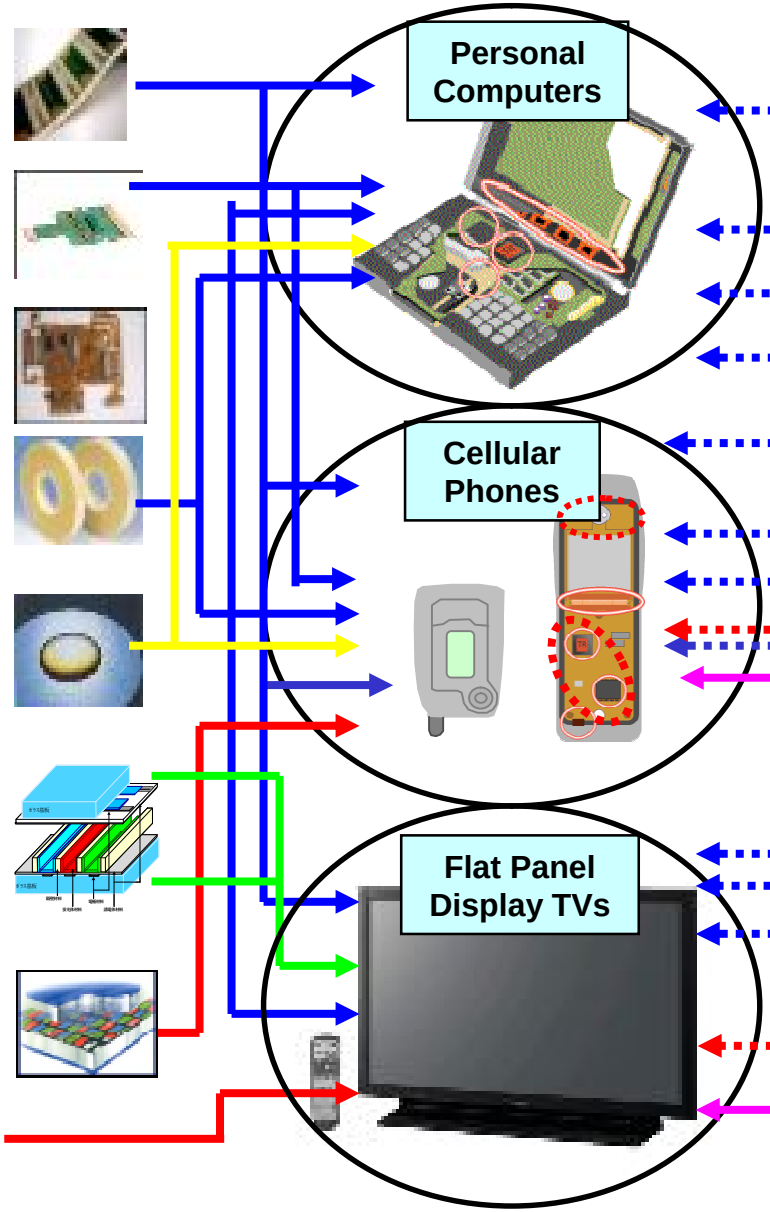
Semiconductor-related Materials (polyimide coating material)

PDP Materials

PDP-related Materials

LCD Color Filters (Medium/Small)

TFT Planarization Materials

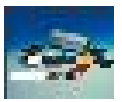



PET Film (release film, etc.)

PPS Film

Aramid Film

Engineering Plastic Resins (PPS, LCP, etc.)



Optical PET Film (reflective film, etc.)

COG Bonder

Slit Coater

# Major Capital Expenditures

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* capacities are annual production bases

## Toray

Optical PET film 5,400 → 10,800 tons (operation started in Sep/06)

PDP paste material 2,700 → 5,160 tons (1st stage operation started in Jun/07)

Posi-type photosensitive polyimide 48 → 144 tons
(operation started in Aug/07)

## Toray Advanced Film : TAF

Two-layer copper clad laminate film for COF tapes 1,000,000 → 1,200,000m$^2$
(operation started in Apr/06)

## Toray Saehan : TSI (joint venture with Saehan Inc. (Korea))

Electronics & information-related film processing facility 84 million m$^2$
(operation started in Mar/06)

Optical PET film 13,200 tons (operation started in 1st half of FY 2007)

Two-layer copper clad laminate film for COF tape 700,000 m$^2$
(operation will start in Oct/07)

## STEMCO (joint venture with Samsung Electro-Mechanics (Korea))

TAB, COF tape 468 → 708 million pieces (operation started in Mar/07)

**Proactive capital investments in Japan and Korea.**

# Business Results Trends of IT-related Products Segment

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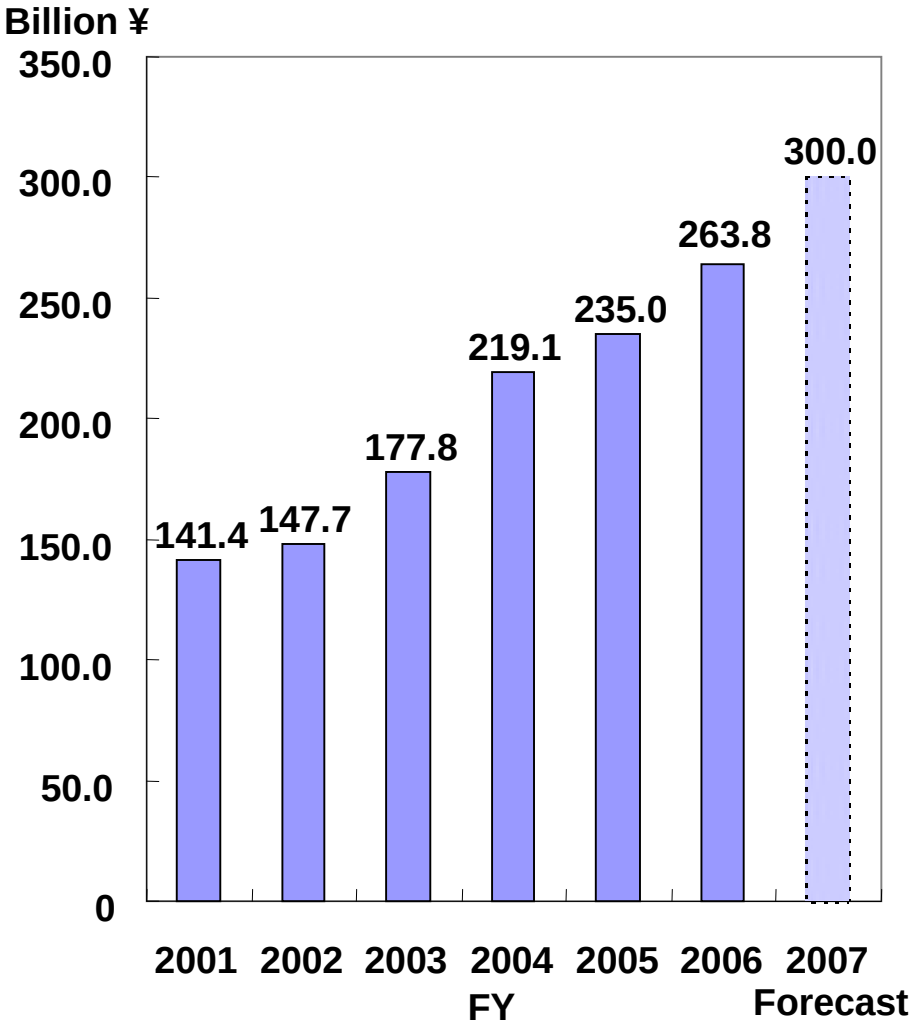
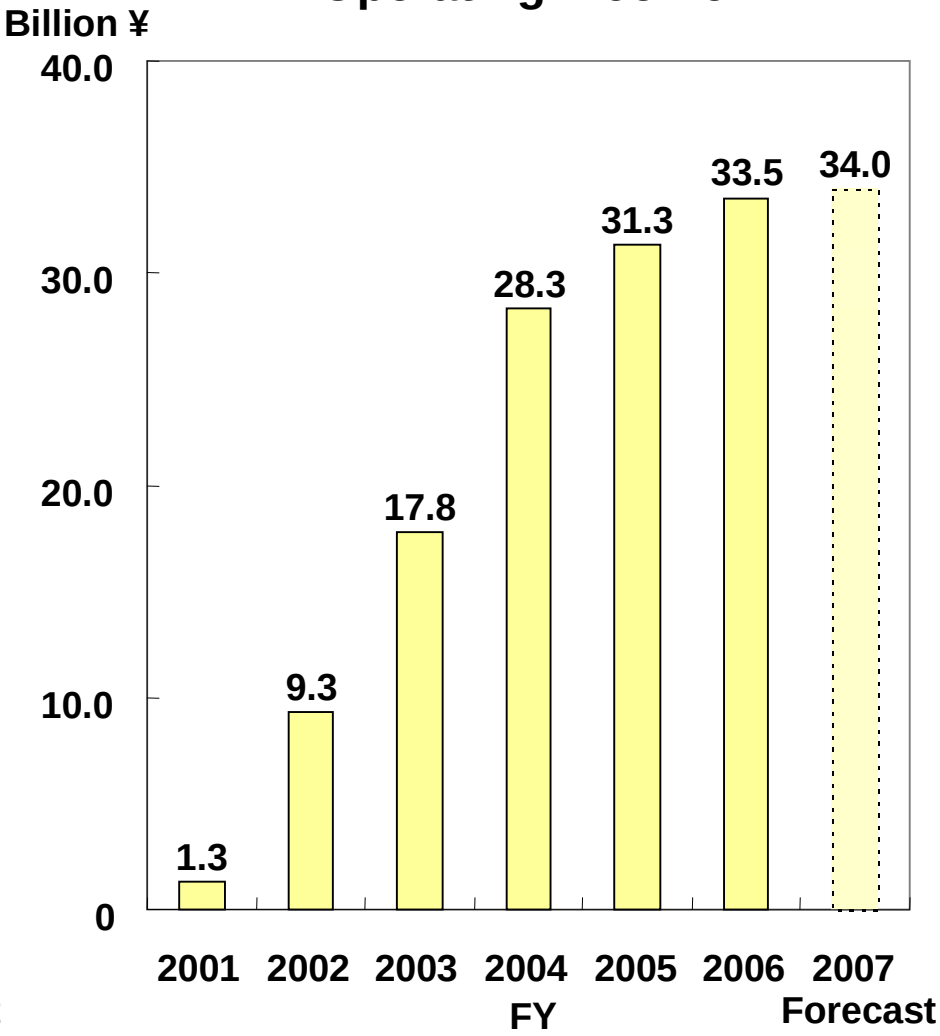
## Net Sales



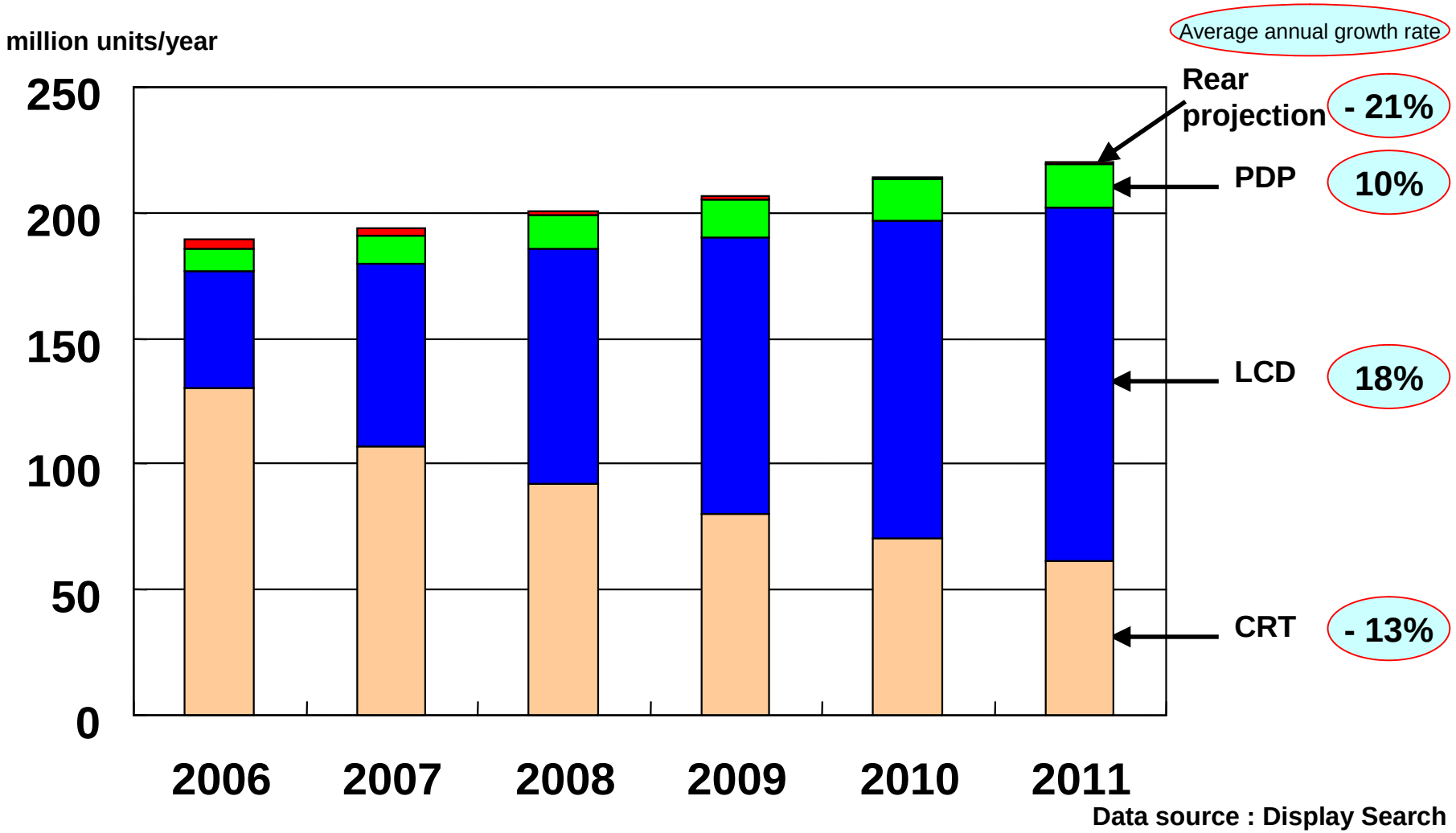

## Operating Income



# II. Business Strategies for Major Products

## 1. Flat panel display TV-related products

# Shipment Volume Trends of Flat Panel Display TVs by Display Type




Data source : Display Search

- Flat panel display TV ratio will expand 2007:43% → 2011:72%
- LCD will replace CRT by share in FY2008

# Polyester Film Lumirror* for LCD

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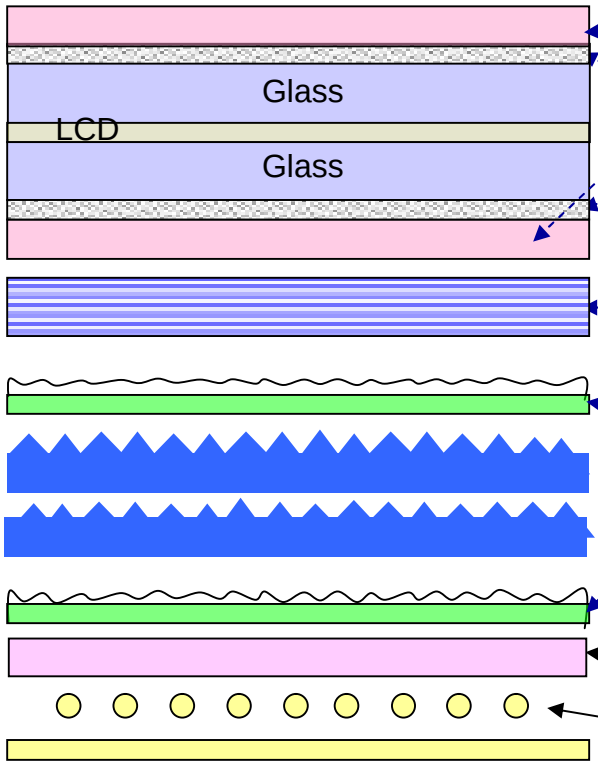
## LCD Panel Composition Example




## Toray Products

- Polarizer
  - Polarizer protection film (antistatic processing)
  - Release film for separator (silicon processing)
- Retardation film
- Luminance improvement film
- Diffusion sheet
  - Base film for Diffusion sheet
- Prism sheet
  - Base film for Prism sheet
- Diffuser
- Cold cathode Fluorescent tube
- Reflector
  - Reflector (base film/anti-UV processing)

# Toray Slit Nozel Coater (TS Coater)

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**Number one seller in slit coaters for color filters of the size over G5**

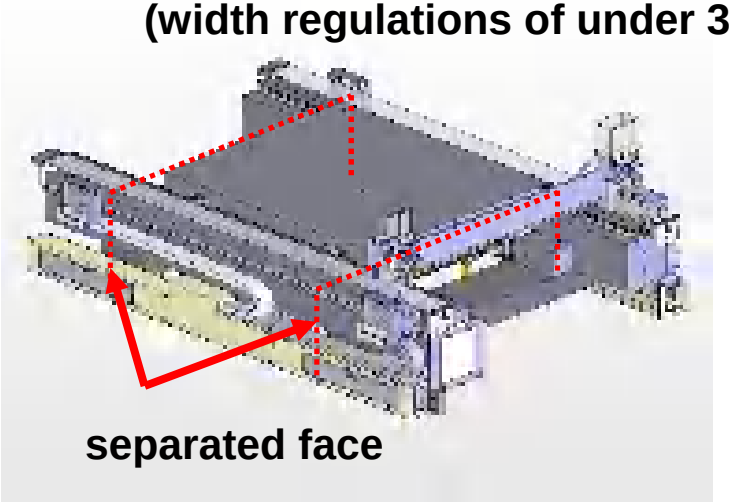
*G5 size (1,100mm x 1,300mm)

**Start designing of slit coater for G10 with delivery planned in Autumn 2008**

*G10 size (2,850~3,130mm x 3,050~3,500mm)

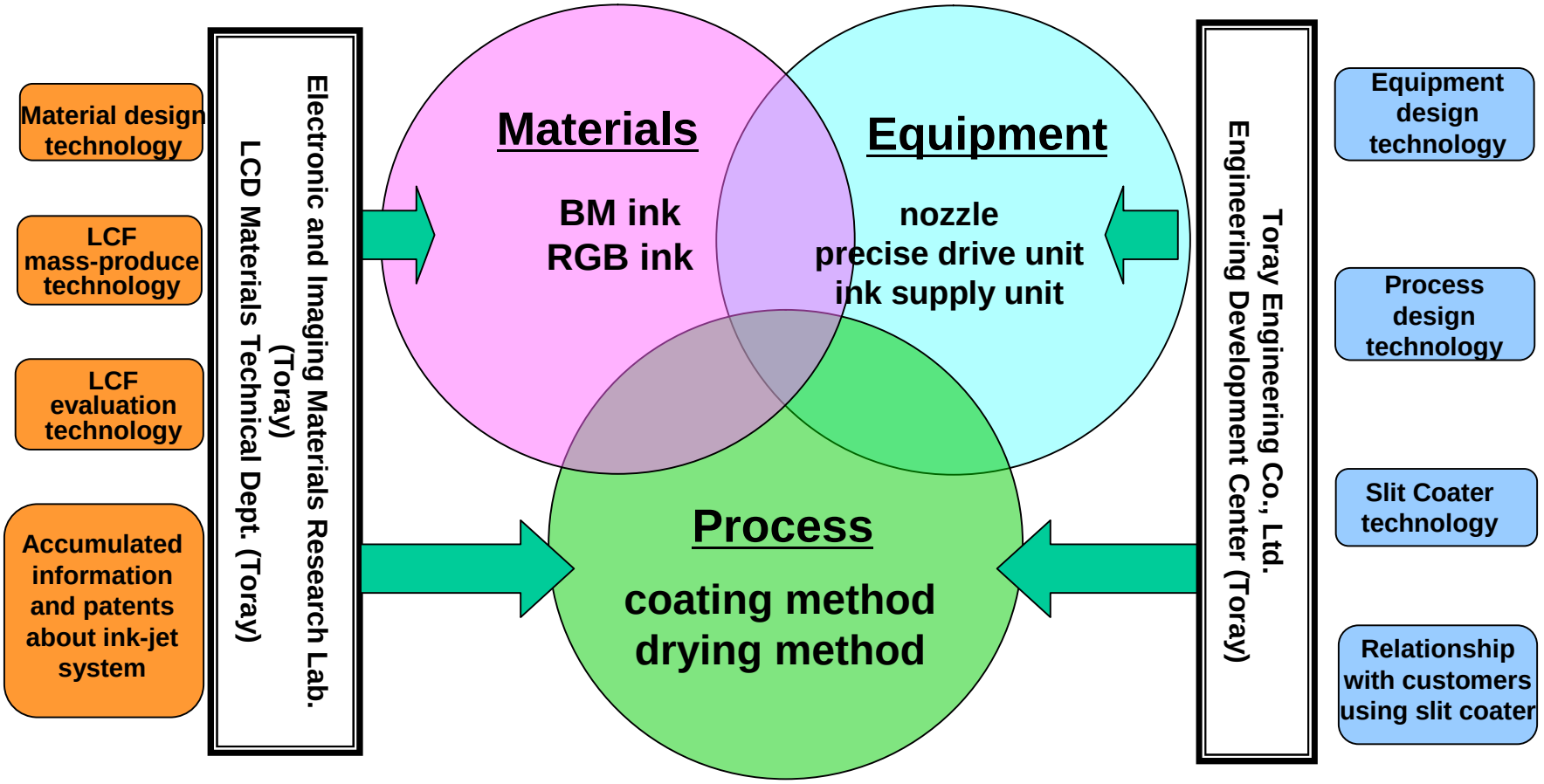
①Main specification : coating accuracy and quality is the same as G8
; tact time is the same as or superior to G8

②Special specification of G10 : can be split and delivered in pieces and assembled on site in accordance with the Road Trucking Vehicle Law (width regulations of under 3,200mm)




- Assembling accuracy needed to reassemble the equipment on site after separating into pieces smaller than 3,150mm to deliver them according to the Road Trucking Vehicle Law
- Coating performance after reassembling has been proved and verified with G8

# Development System of Ink-jet Color Filters




**History**

2005 Started development of fundamental technology focusing on LCD TVs
2006 Completed test coating facility of G7.5(*) and started test operation

* G7.5 size：2,000 x 2,250mm

**Strongly enhance development with Toray Group's all-out efforts.**

# Toray Ink-jet Color Filter Coating Equipment

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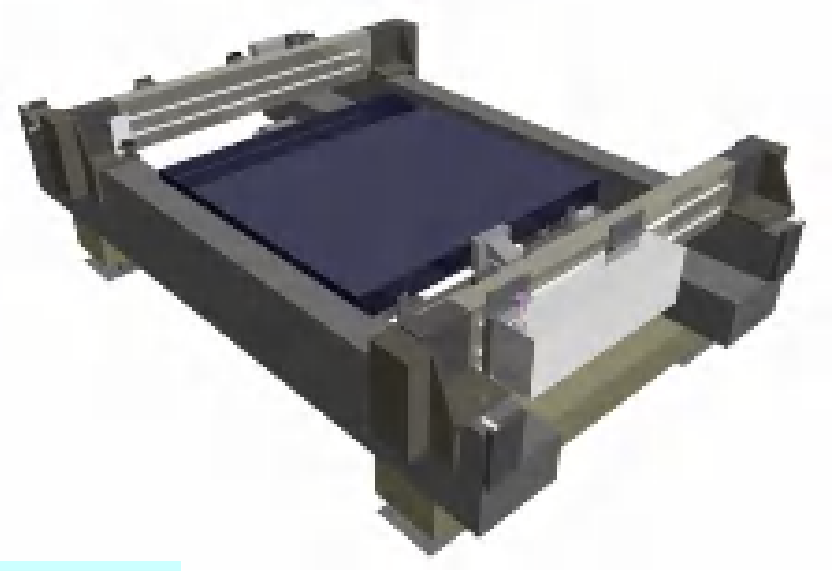
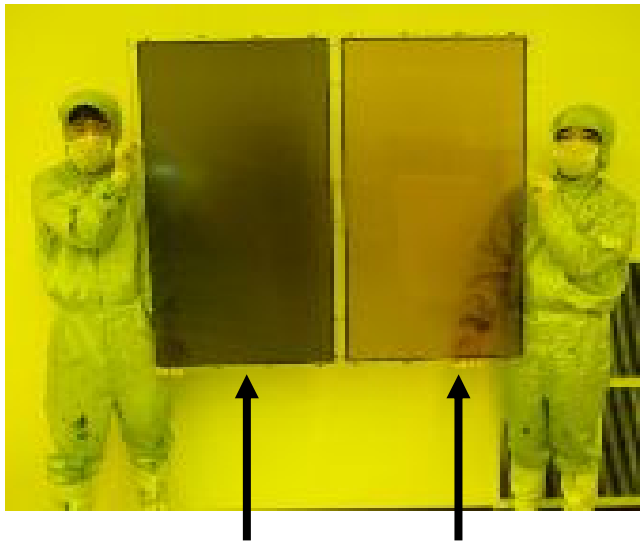
## Equipment image



## Appearance of coating



coating of RGB 3 colors

coating of R only

## Features

1. Level pixel surface after coating
2. Less defect or pixel overflow process
3. Less color variation through unique dispersion technology
4. Able to examine the nozzle online

## Future Plans

Aim for production verification of in FY 2008 and receive orders in FY 2009

# Business Strategies for FPD TV-related Products

- **LCD TV-related**
  - **Optical film**
    - Not only selling base films, Toray expands downstream processing businesses including high performance films utilizing unique advanced technologies
  - **TFT planarization material Photoclear***
    - Full-scale application for major TVs
  - **Slit-nozzle coater**
    - Continue top share in generation G5 and larger, as well as development of G10 corresponding products
  - **Ink-jet coating equipment**
    - Realize adoption by major panel manufacturers by utilizing Toray Group's all-out efforts for combined development of materials, equipment and process
- **PDP TV-related**
  - Develop paste materials compatible with the enhanced PDP performance
  - Expand capacity of paste materials to meet the production increase of panels at MPDP
  - Business expansion through development of new paste materials other than rear panels

# Ⅱ. Business Strategies for Major Products

## 2. Semiconductor-related products

# Expansion of Polyimide Coating Market

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## Volume increase of semiconductors

Average annual growth rate (2006 → 2010)
DRAM : 20%, flash memory : 12%,
MPU : 7%

* source : Gartner, Inc.

## High density IC packages

1. finer pitch (super fine pitch)
2. multi-layers (stacked package)

QFP (existing package) Stacked package

## Advancement in car electronics

volume increase of in-vehicle semiconductors

## Expansion of polyimide buffer coating market

Adoption in high growth potential semiconductors

- Requirements for pattern processing in response to fine pitch and stress buffer
- Requirements for improvement in adhesiveness between multilayer chips

Requirement for higher reliability for heat and impact resistance for automobile use

**Growing importance of semiconductor buffer coating leads to market expansion of polyimide coatings.**

# Toray History in Development of Polyimide Coatings

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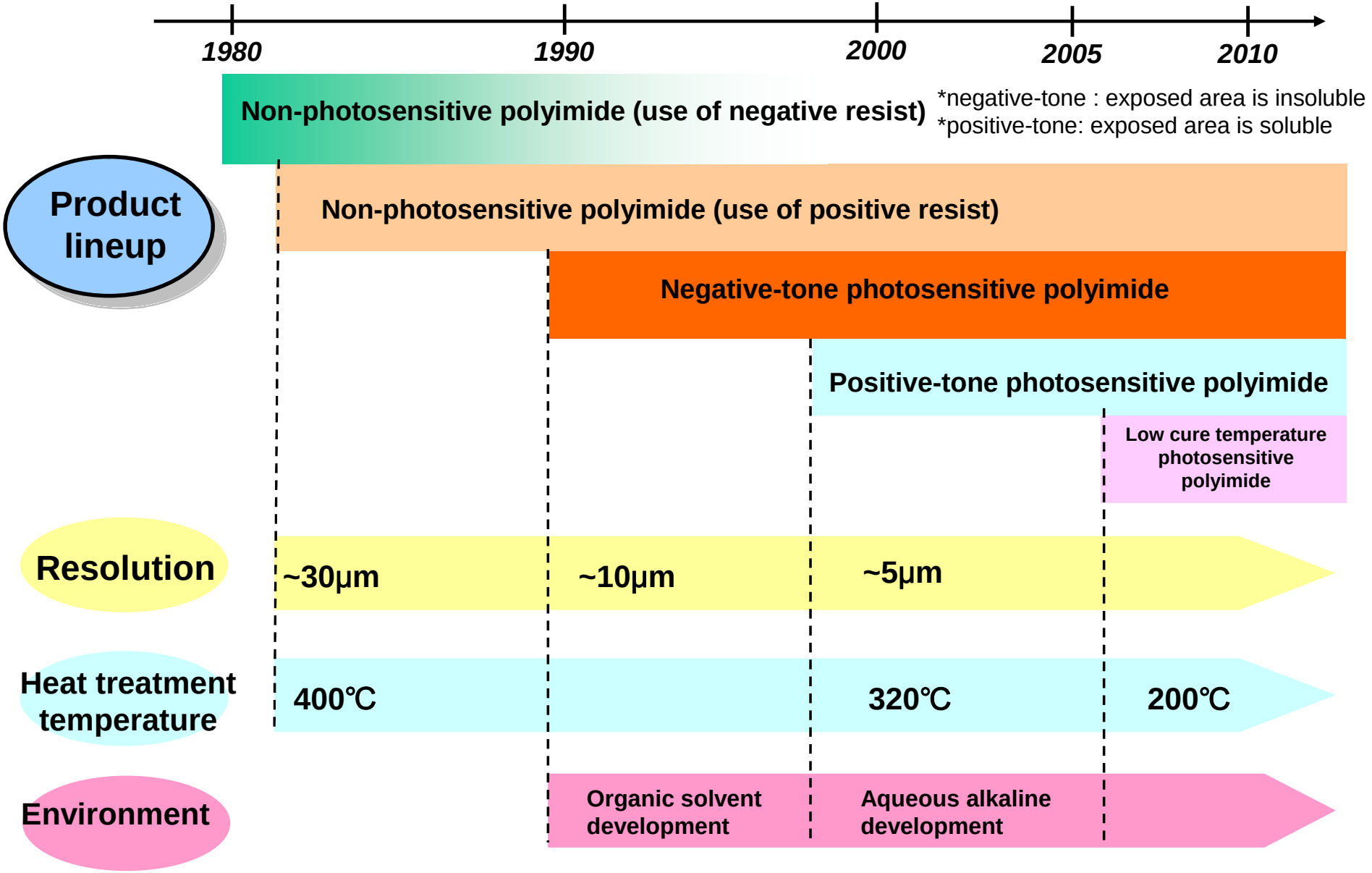
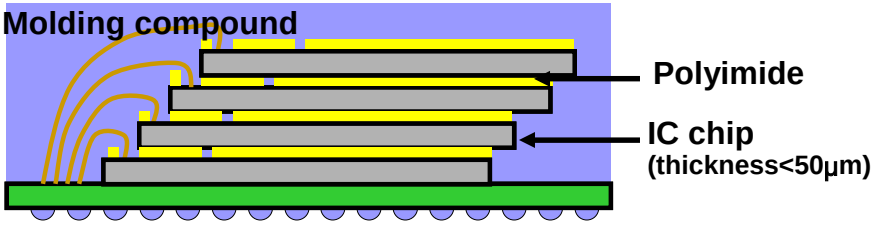


# Polyimide Coatings for Flash Memory Coating

## Development trends of flash memory

Super fine pitch wiring (65nm → 50nm or finer)
Thinner chip due to multilayer stack (<50μm)




## Features of Toray positive-tone polyimide coatings

- High resolution : 3μm angular size possible with coating thickness 8μm
- High accuracy in pattern processing : 5±0.25μm with 300mm wafer
- Realizing high throughput with high sensitivity
- Excellent adhesiveness with various metals (Cu, etc.) and silicone substrate
- Excellent stress relief
- Excellent chemical resistance : flux resistance (acid resistance), etc.

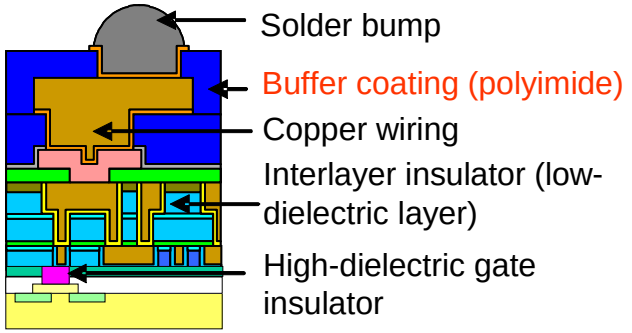
**Responding to the customers' requirements for good quality, Toray occupies a high share in buffer coatings for flash memory.**

# Low Cure Temperature Photosensitive Polyimide Coatings

## Development background

**Issues of new materials to meet the next generation LSI (high speed)**

1. Low-K interlayer dielectrics :
   porous structure and low heat-resistance
2. High-dielectric gate insulator :
   crystalline state changes by heat




## Toray's low cure temperature photosensitive polyimide coatings

| Requirements | Characteristics of the Product |
|---|---|
| 1. Cure at low temperature → | heat treatment temperature is about 200℃ (conventionally 350℃) |
| 2. Low Shrinkage after curing → | shrinkage after curing is about 10% |
| 3. High heat-resistance → | heat stability after curing is over 300℃ |
| 4. Good adhesiveness → | excellent adhesiveness with various metals (copper, aluminum, etc.) |
| 5. Environmental responsibility → | Aqueous alkaline development (conventional type: organic solvent) |

**Toray is the pioneer in developing this low cure temperature photosensitive polyimide which corresponds to low temperature processing of next generation LSIs and the product is under evaluation at the world's major semiconductor manufacturers.**

# CMP for Multilayer Wiring of Semiconductors

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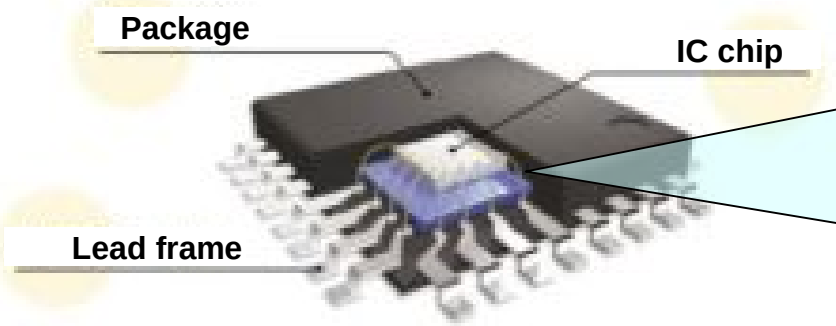
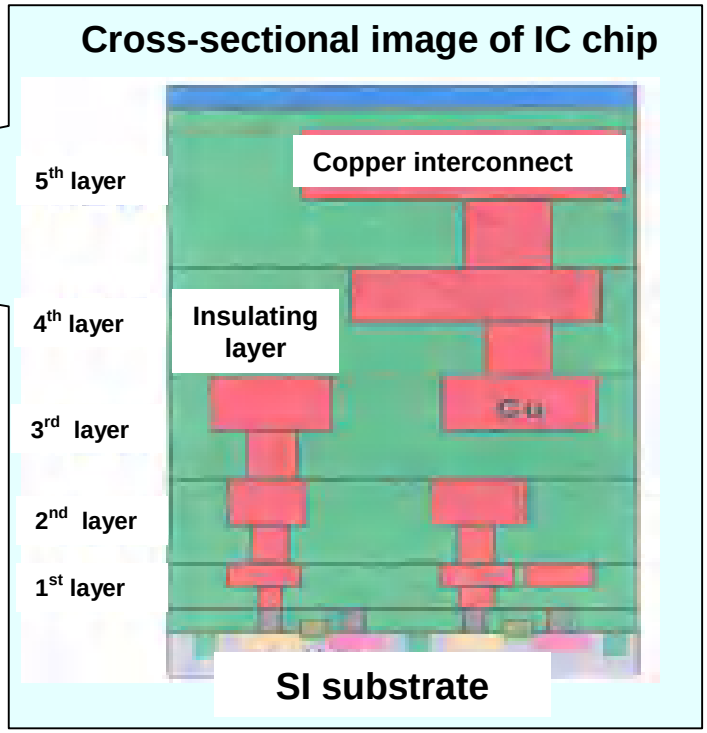
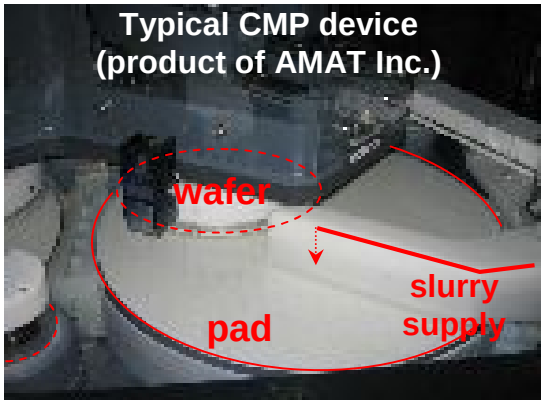
## - Chemical Mechanical Polishing (CMP) -



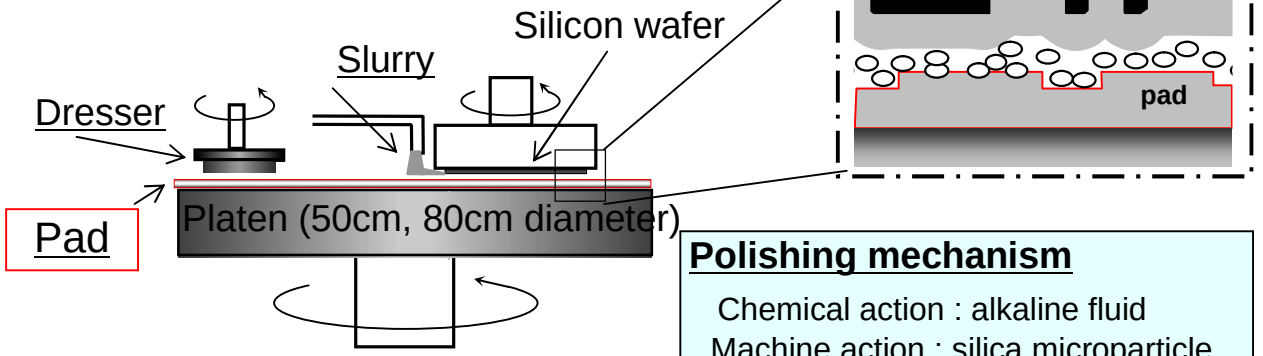

1. Increase in multilayer wiring of semiconductors (IC chip)
2. Planarization of each layer is indispensable to prevent the lowering of electric property or patterning reliability due to the surface irregularity

→ **CMP is essential**



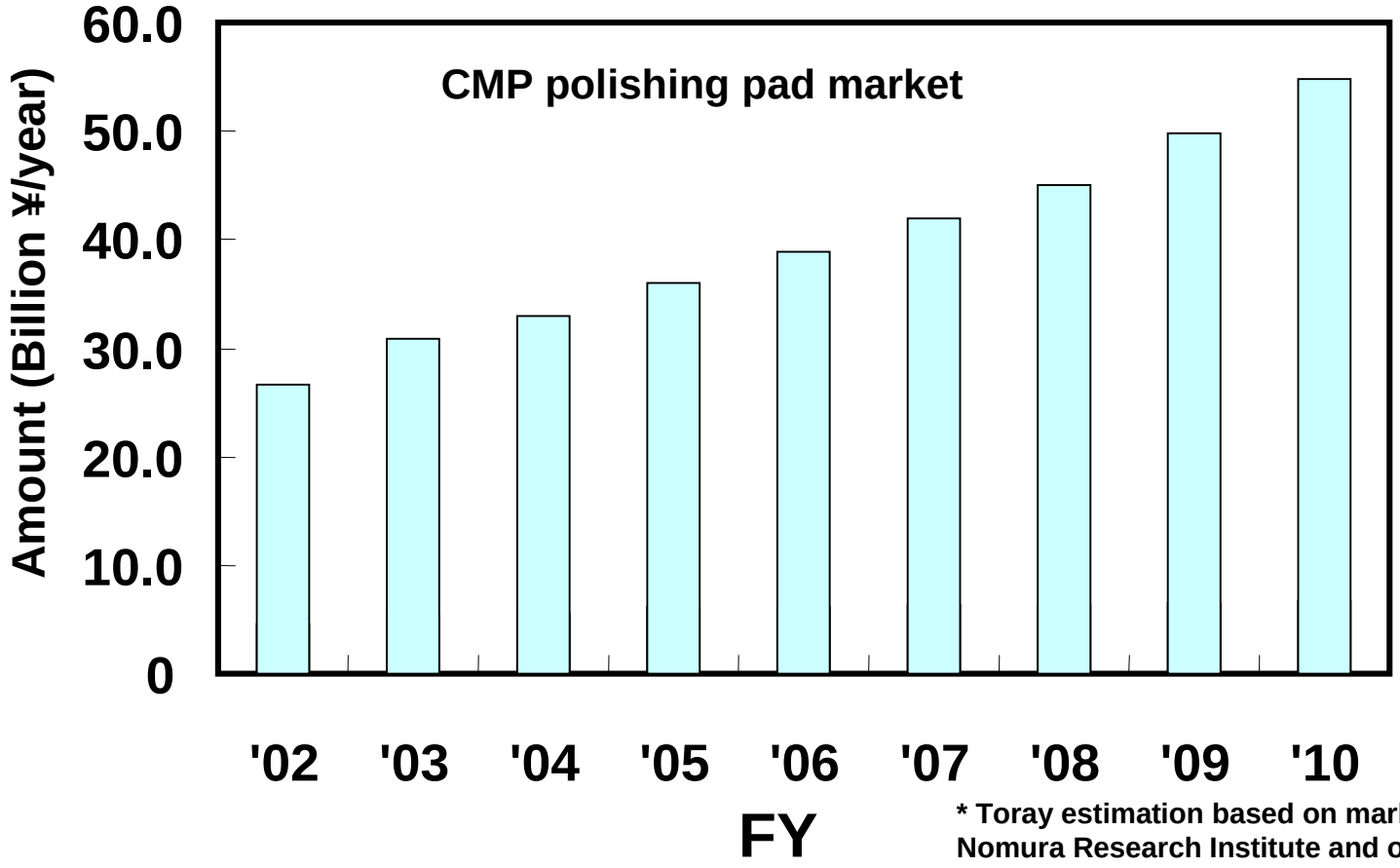

**Model fig. of CMP polishing device**




**Polishing mechanism**

Chemical action : alkaline fluid
Machine action : silica microparticle

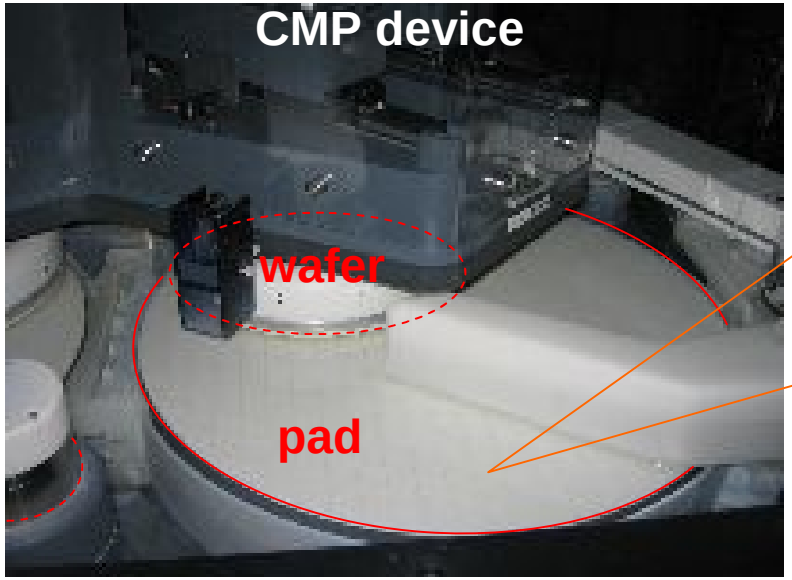
# Market Condition of CMP Polishing Pad



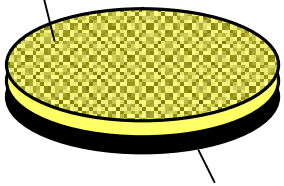

* Toray estimation based on market survey materials of Nomura Research Institute and others as well as hearing information of the industry

1. Supported by the world-wide strong semiconductor market, the CMP polishing market increased by roughly 10% over FY '05. Demand is strong and 44 billion yen scale is expected in FY 2007.
2. Protected by strong patents, US products have become de facto standard and are dominating (95% market share) the market.

# CMP Polishing Pad - Chemical Mechanical Polishing -




**Polishing pad**




**Creative Technology**

- Can easily control hardness of the combined pad of polishing and cushion layers
- Patent acquired (Japan, US, EU, etc.)

## Features of Toray polishing pad

1. High polishing properties
   - high polishing speed and few defects
   - excellent uniformity
2. Long product cycle
   (1.2 times longer than conventional type under standard conditions)
3. Slurry saving
   (reduced by half of conventional type under standard conditions)

**Continuously adopted from FY '06 with 300mm wafer of major semiconductor manufacturers.**

# Development of New IC Bonding Material (Wafer Level NCF)

## Conventional Method (ACF method)

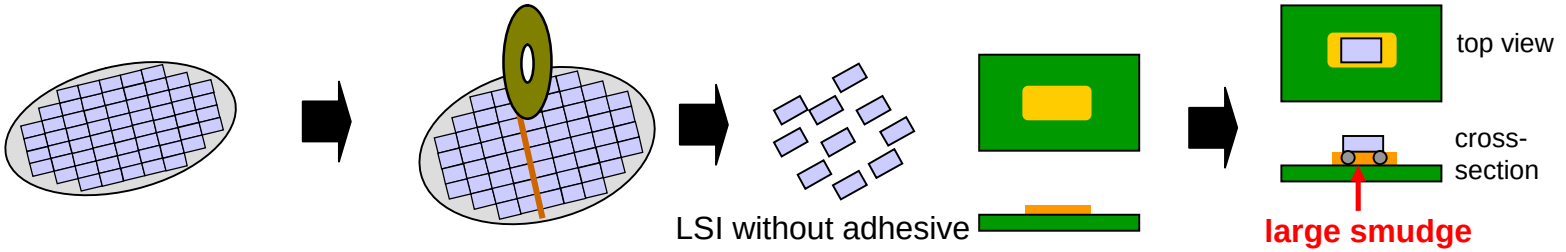
Process time: about 170 minutes

**LSI-processed wafer**

**Dicing (dice LSI) *to 1,000 pieces** — **20 minutes**

**ACF (adhesive sheet) pasting** — **50 minutes**

**LSI bonding *to 1,000 pieces** — **100 minutes**




## Toray Method (Wafer Level NCF method)

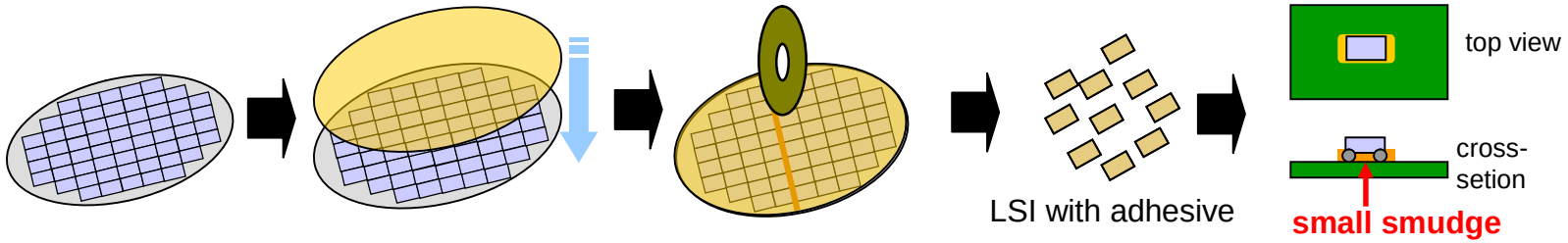
Process time : about 120 minutes

**LSI-processed wafer**

**Laminate NCF (adhesive sheet)** — **10 seconds**

**Dicing (dice LSI) *to 1,000 pieces** — **20 minutes**

**LSI bonding * to 1,000 pieces** — **100 minutes**



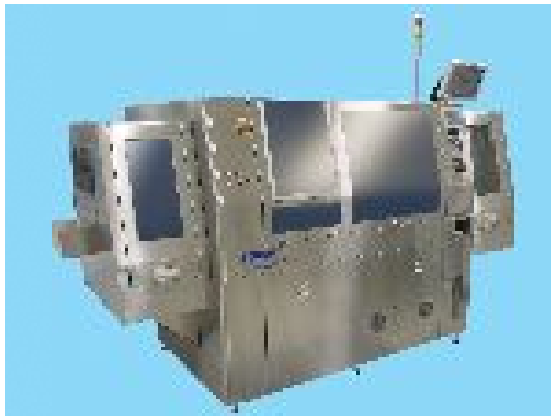

*this process time is just an example and actual process time differs in facilities or processes of each company

**Toray aims for the world's first practical realization through the shortening of lead time and the minimization of bonding area.**

# Toray Group Semiconductor Manufacturing Equipment

## 1. IC bonding equipment

**Flip-chip bonder FC3000**



**General-type bonder for thermo-compression of multilayer chip, etc. and ultrasonic bonding**

**Large-size substrate corresponding bonder MD3500**

**Bonder for large-size substrates up to 560mm x 610mm which realizes high-accuracy of ±5μm**

## 2. Automatic wafer inspection equipment

**As a front-end process of CMP or etching, it can inspect every wafer in process with ultra-high speed and high reliability**

**INSPECTRA 7000R300**

# Business Strategies for Semiconductor-related Materials

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- **Polyimide coatings**
  - Strengthen product lineups of non-photosensitive, negative-tone, positive-tone, and low cure temperature type coatings
  - Upgrade performance of positive-tone through close efforts with major semiconductor manufacturers and promote share increase as well as production capacity expansion
  - Realize commercial production of next generation low cure temperature type as soon as possible
- **CMP polishing pad**
  - Expand adoption of insulators by major semiconductor manufacturer and increase application for metal layers (W, Cu) which are under evaluation by customers
  - Establish mass-production system with cost competitiveness
- **New IC bonding material (Wafer Level NCF)**
  - Realize shortening of lead time and minimization of bonding area, and put into practical use as soon as possible
- **Semiconductor manufacturing equipment**
  - Expand business focusing on IC bonding and wafer inspection equipment

# II. Business Strategies for Major Products

## 3. Cellular phone-related products

# Higher Resolution Required for Cellular Phones TFT-LCD

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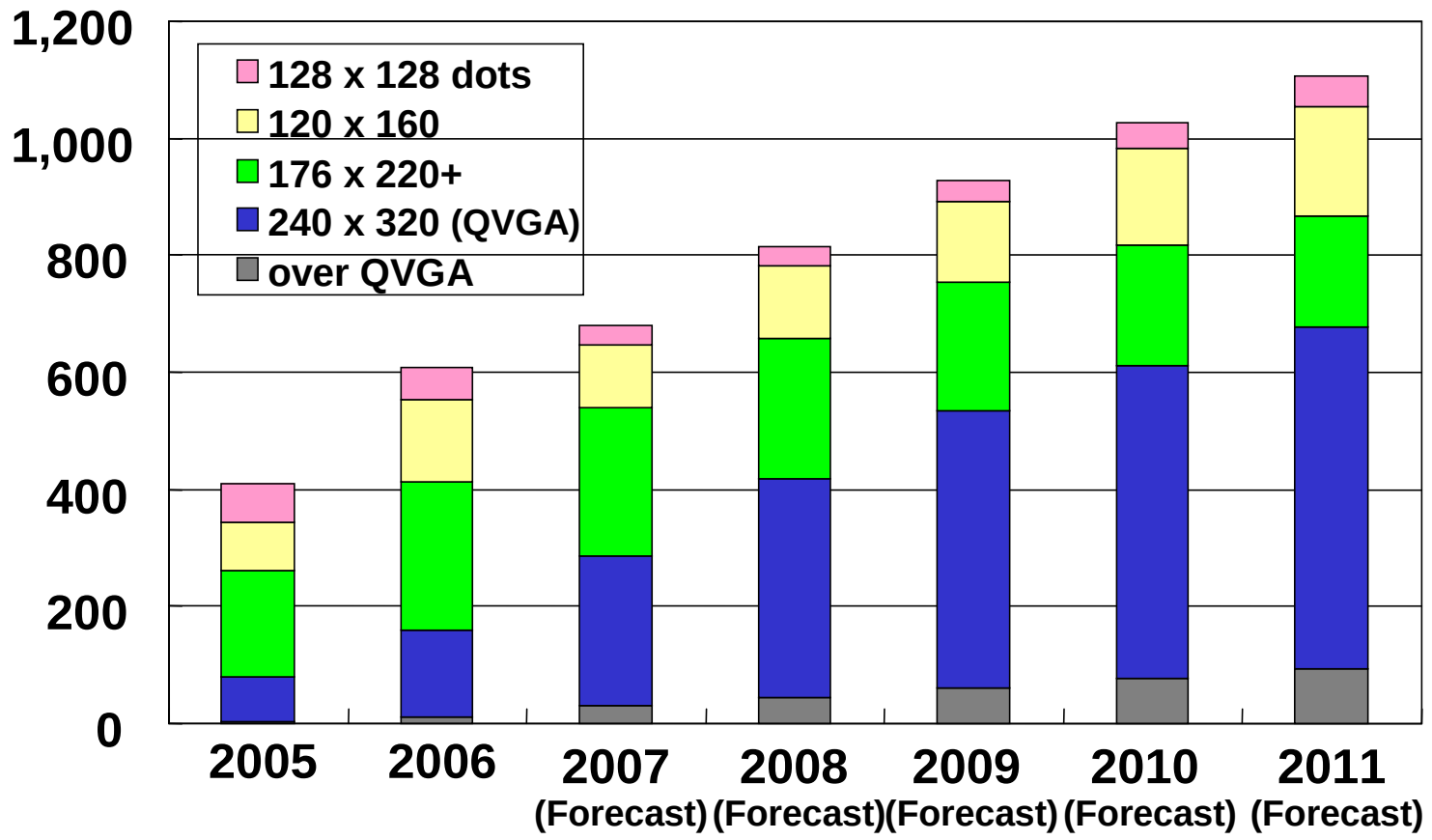
**Long-term Forecast of TFT-LCD for Cellular Phones**




**In response to starting mobile terrestrial digital audio/video and data broadcasting services, high-resolution panels are growing rapidly centering on QVGA or higher.**

Data source : Display Search

# Features of Toray Medium and Small Size Color Filters

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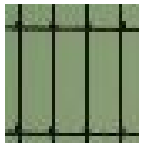
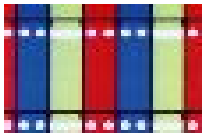
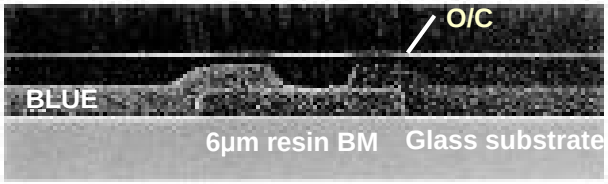
| Features of Toray color filters | Contributions to LCD |
|---|---|
| **①Thinning　Microfabrication**<br>・Resin BM：maintains high OD and realize thinner and finer BM patterning<br>・Trans-reflective CF：can shape ultrafine holes<br>  <br>~mass production~<br>OD : 5 and over<br>BM line width : 5μm<br>  <br>minimum hole diameter of trans-reflective CF :8μm | ・realize high definition<br>・improve brightness<br>・reduce power consumption |
| **②High color purity**<br>・Mass production of high-definition, trans-reflective products with high color purity<br>・Great flexibility in color purity design | ・improve color purity<br>・realize high definition |
| **③Planarity**<br>・Planarity variation improved with high transparent over coat technology<br>  | ・improve image quality through uniforming LC cell gap<br>・enhance yield through improvement of LC dripping process margin |

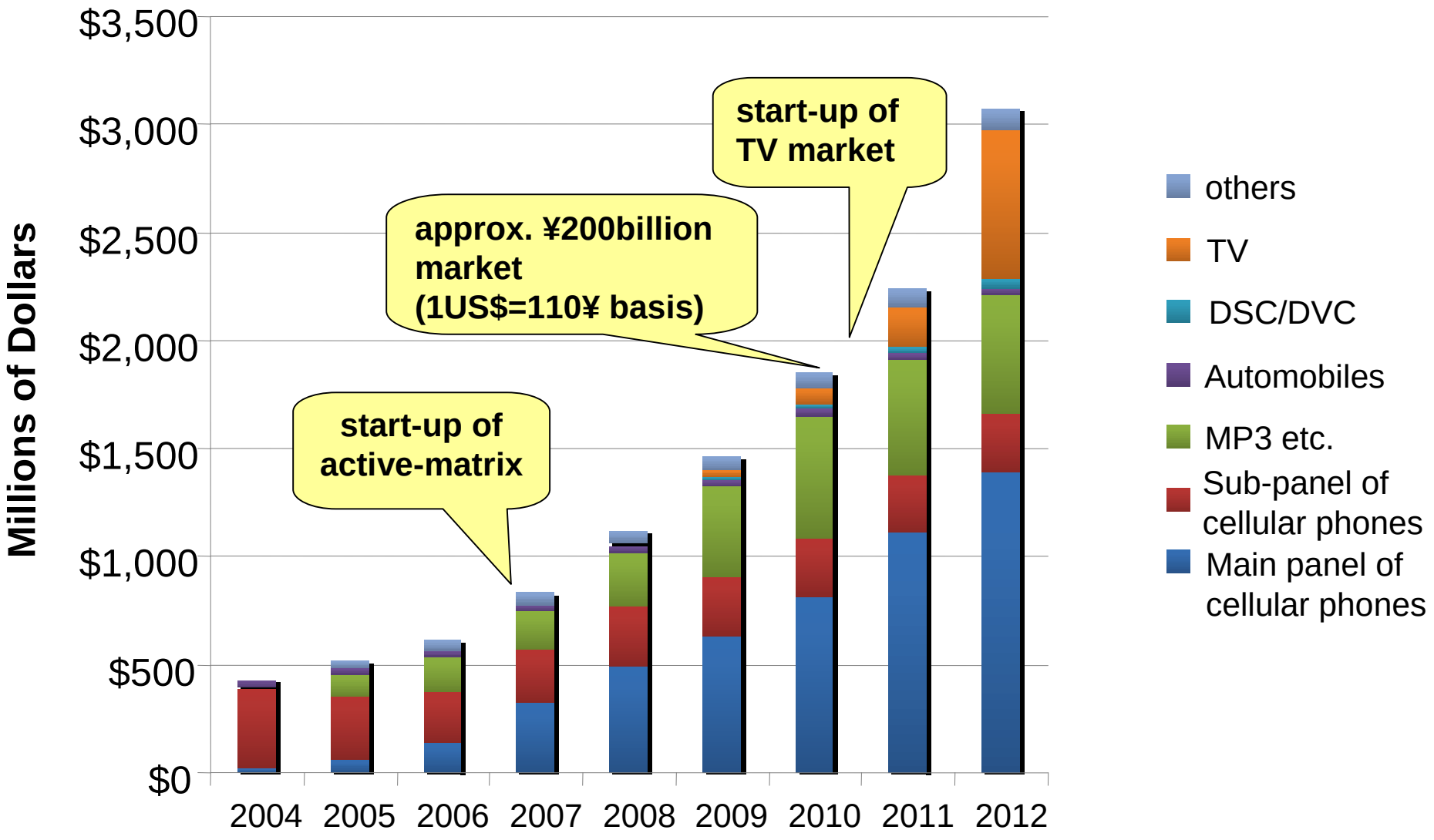
**Toray high-definition color filters are suitable for low temperature polysilicon TFT with QVGA or higher.**

- **LCD color filters**
  - **Firmly maintain the world No. 1 market share (about 20%) as a manufacturer of medium and small size color filters mainly for cellular phones**
  - **Develop technology to produce high-definition, high-performance displays at low cost and commercialize products as soon as possible**
  - **Strengthen compatibility to high-mix low-volume production**

# II. Business Strategies for Major Products

## 4. Organic EL-related products

# Market Scale of Organic EL Panels by Application

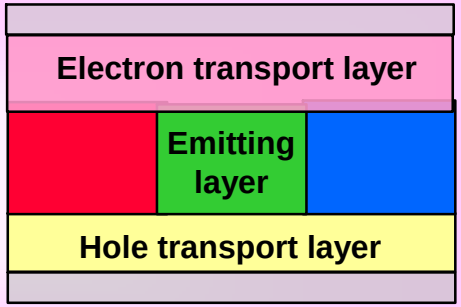



**Data source : Eyesupply Japan**

# Organic EL-related Emitting Materials

## Strength of Toray organic EL-related emitting materials

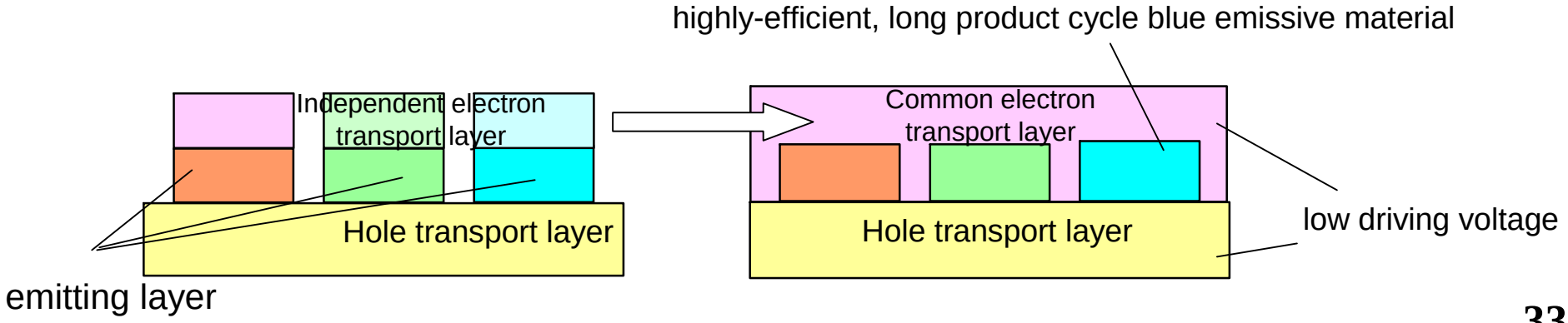
1. **Lowest driving voltage of electron transport layer materials in the market**
2. **Red light emissive material (dopant) is top-level in emitting materials with high-efficiency and long life as fluorescent materials**




## Development Strategies

**Aim to be a comprehensive organic EL material manufacturer**

- **develop highly-efficient, long life blue and green light emissive material**
- **develop hole transport layer material and nurture it into de facto products together with electron transport layer material**
- **standardize RGB of electron transport layer and strengthen product competitiveness with low driving voltage**



TORAY
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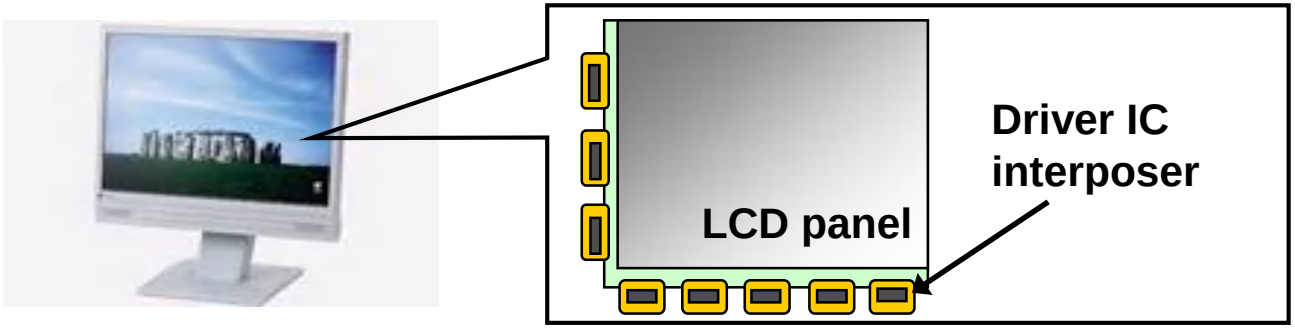
- **Organic EL-related products**
  - **Promptly develop blue light emissive material and hole transport layer material compatible with Toray's unique high-performance emitting materials (electron transport material and red light emissive material)**

# II. Business Strategies for Major Products

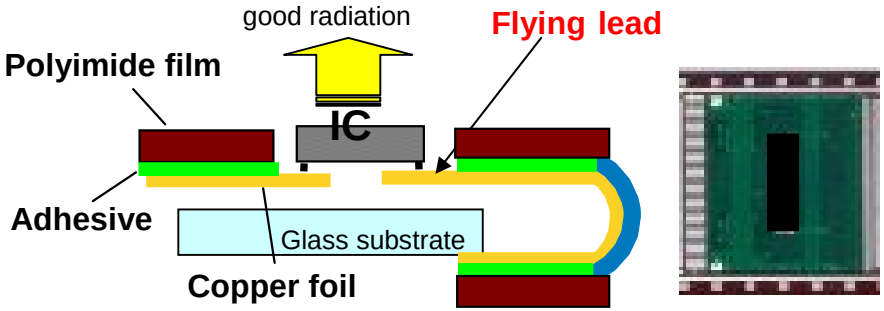
## 5. Circuit-related materials

# Structure of LCD Driver IC Bonding




## TAB method

**TAB = Tape Automated Bonding**



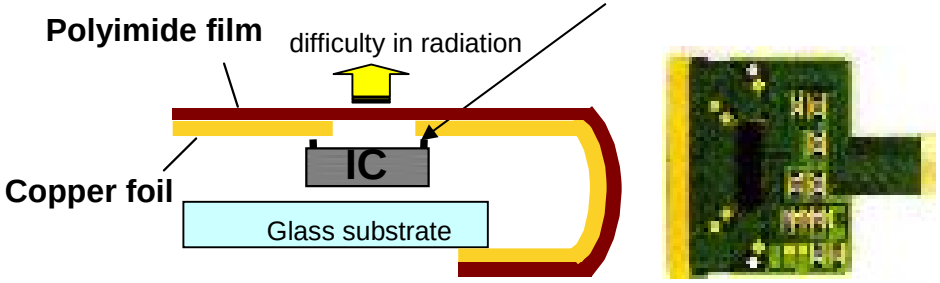

**Despite of difficulties in fine pitch, flying lead structure has good heat radiation properties as the IC is located outside of the glass substrate (at the polyimide side)**
**→ preferable for high-voltage usage including PDPs**

**Three-layer material used with epoxy adhesive**

## COF method

**COF = Chip On Film**

**Flip-chip bonding**



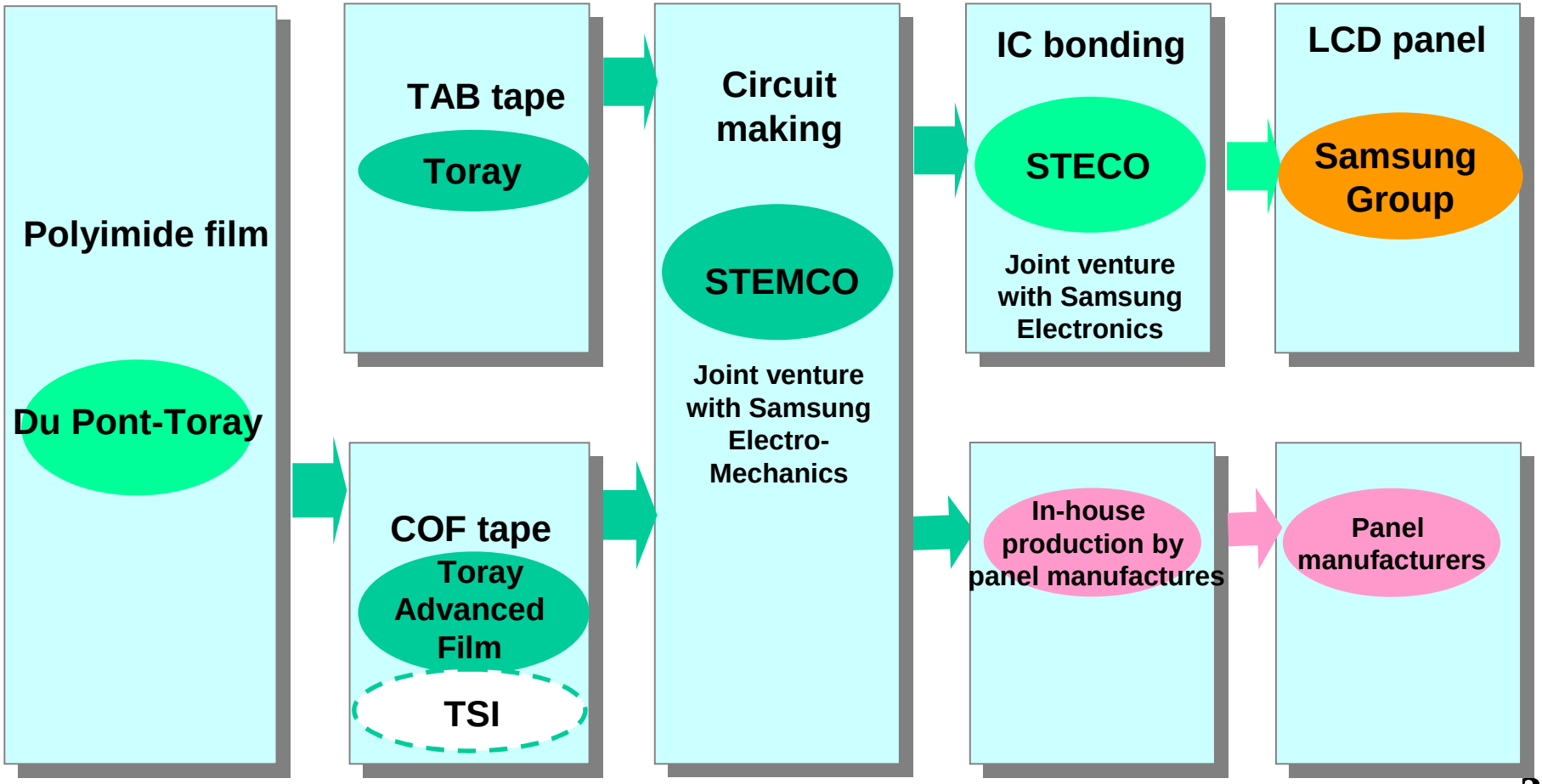

**Although difficulties in heat radiation properties, fine pitch wiring is possible as the IC is located inside of the glass substrate (at the copper foil side)**
**→preferable for low-voltage usage including LCDs**

**Two-layer plating material used**

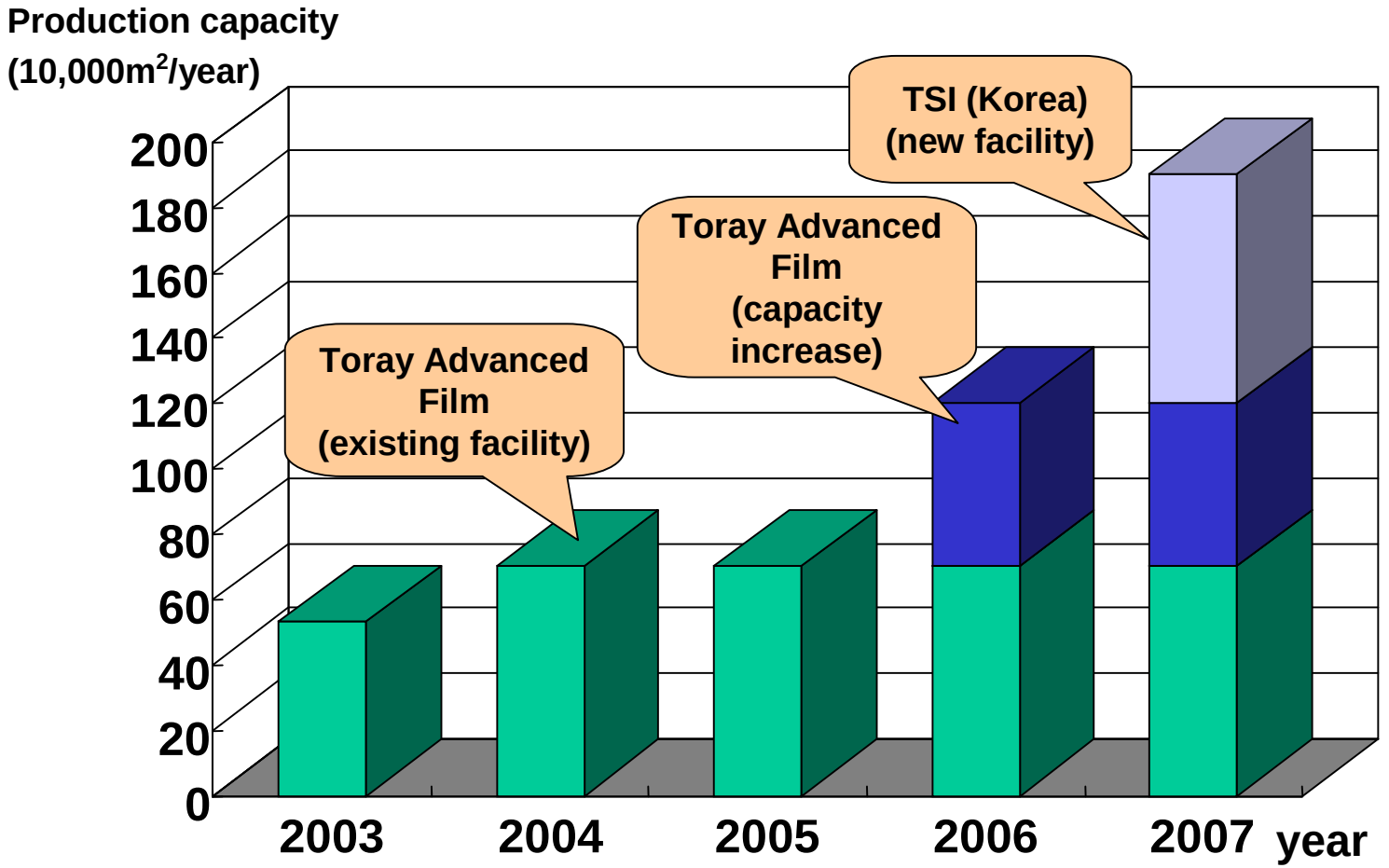
# Supply Chain of LCD Driver IC Bonding Materials

Toray Innovation by Chemistry

**Toray Group is in a leading position in the supply chain of TAB/COF films and polyimide-film-based circuit materials including FPCs.**



# Business Expansion of Metaloyal*




- Capacity increase in Japan (at Toray Advanced Film)
- New operation will start at TSI in Korea through technology transfer to respond quickly to the Korean market

# Toray Technologies of LCD Driver IC Bonding

TORAY
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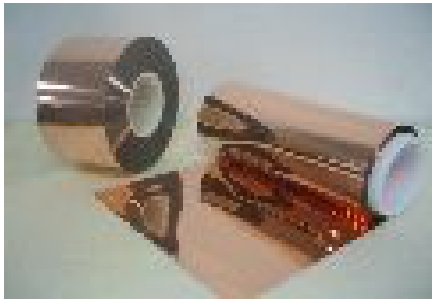
## Roadmap for interconnect pitch of LCD drive ICs

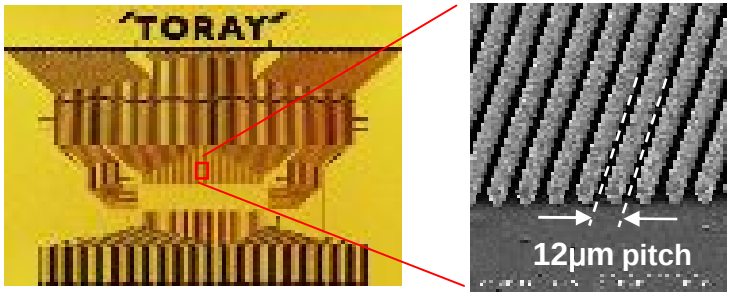
| Pitch (μm) | 40 | 30 | 25 | 20 | 15 | Toray products |
|---|---|---|---|---|---|---|
| Dimensional Tolerance (%) | | ±0.04 | ±0.02 | | ±0.01 | |
| TCP technology | | | | | | Adhesive tapes for TAB |
| Conventional COF technology | | | | | | Toray Advanced Film Metaloyal* |
| Upgraded COF technology (new etching technology) | | | New etching technology | | | |
| Newly developed technology | | | | Available | | Toray semi-additive FORCE |

### Adhesive tapes for TAB

### Toray Advanced Film Co., Ltd. Metaloyal*



### Toray semi-additive method “FORCE”



# Next Generation Microfabrication Technology "FORCE"

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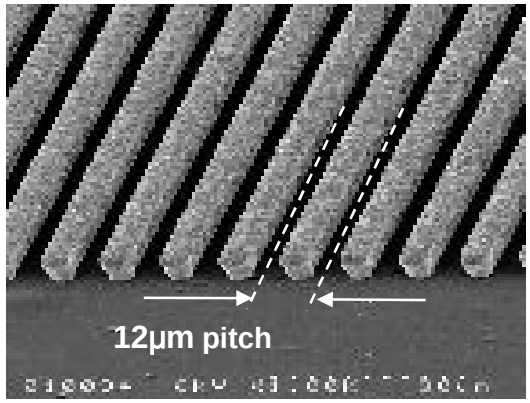
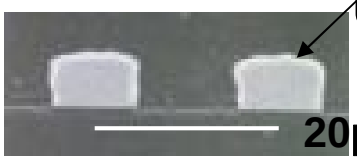



Semi-additive method




Subtractive method


## ■Performance and merits in quality

1. Nano-fabrication of 20μm pitch or finer is possible
   - cost reduction due to downsizing of drive IC
   - reduction of COF substrate area

2. Accumulative fine pitch is ±0.02% or finer
   - increase of bonding margin

3. Rectangular cross section
   - high heat radiation property
   - improved interconnect reliability

4. Small variations in wiring width
   - yield improvement due to increase in bonding margin

**Toray will enter into full-scale business development through establishing test facility to produce one million pieces per month**

- **LCD driver IC bonding materials**
  - **Expand sales of Toray Advanced Film's Metaloyal* (two-layer copper clad laminate film) for the growing COF market as well as promoting production transfer to TSI (Korea)**
  - **In adhesive tapes for TAB (ICC), increase share in the PDP market and maintain or further expand the high share through development of new applications including printers and BGA, etc.**
  - **Launch test facility of "FORCE", semi-additive method, compatible with next generation under 20μm ultrafine interconnect**

# III. Summary

# Positioning of IT-related Products under IT-2010

## Basic Strategies under IT-2010

**Basic Strategy 1**
**Transformation to a highly profitable business group**

**Basic Strategy 2**
**Expansion of advanced materials in four major growing business fields (*)**

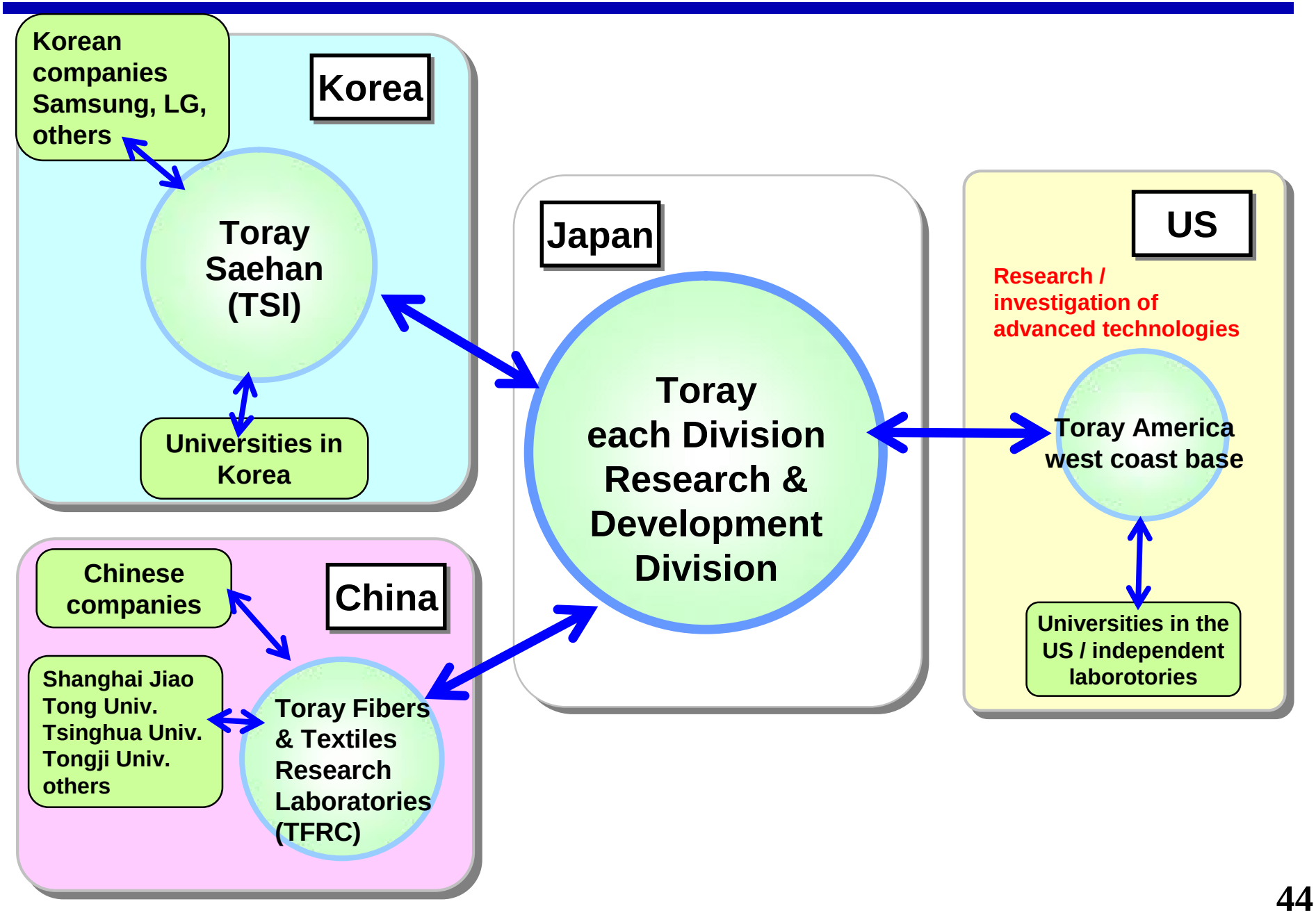
## Positioning of IT-related Products Segment

- Positioned as a growth driver categorized as Strategically Expanding Businesses together with Carbon Fiber Composite Materials Business

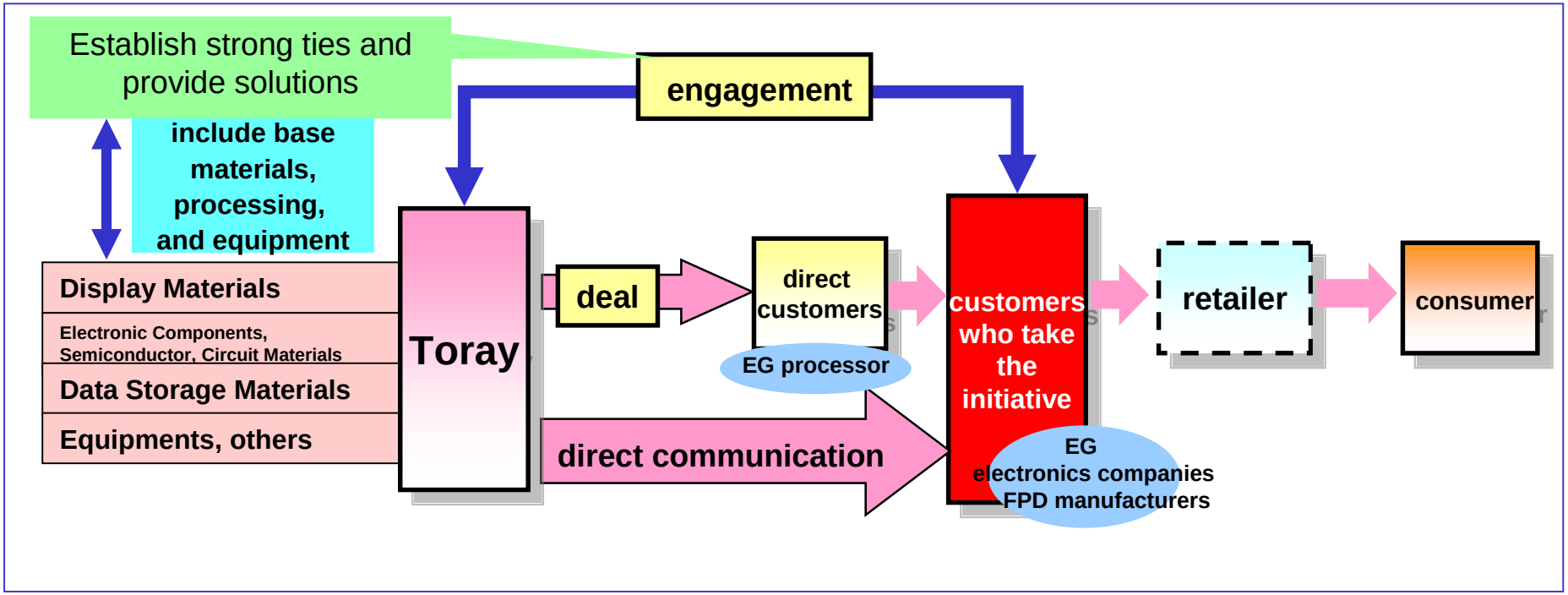
- Not only for Information / Telecommunications / Electronics among the four major growing business fields, Toray will strive for business expansion through development of IT-related advanced materials for Automobiles / Aircraft and Environment / Water-related / Energy

* Toray's four major growing business fields under IT-2010 are:
Information / Telecommunications / Electronics, Automobiles / Aircraft, Life Science, and Environment / Water-related / Energy

# Global R&D Structure

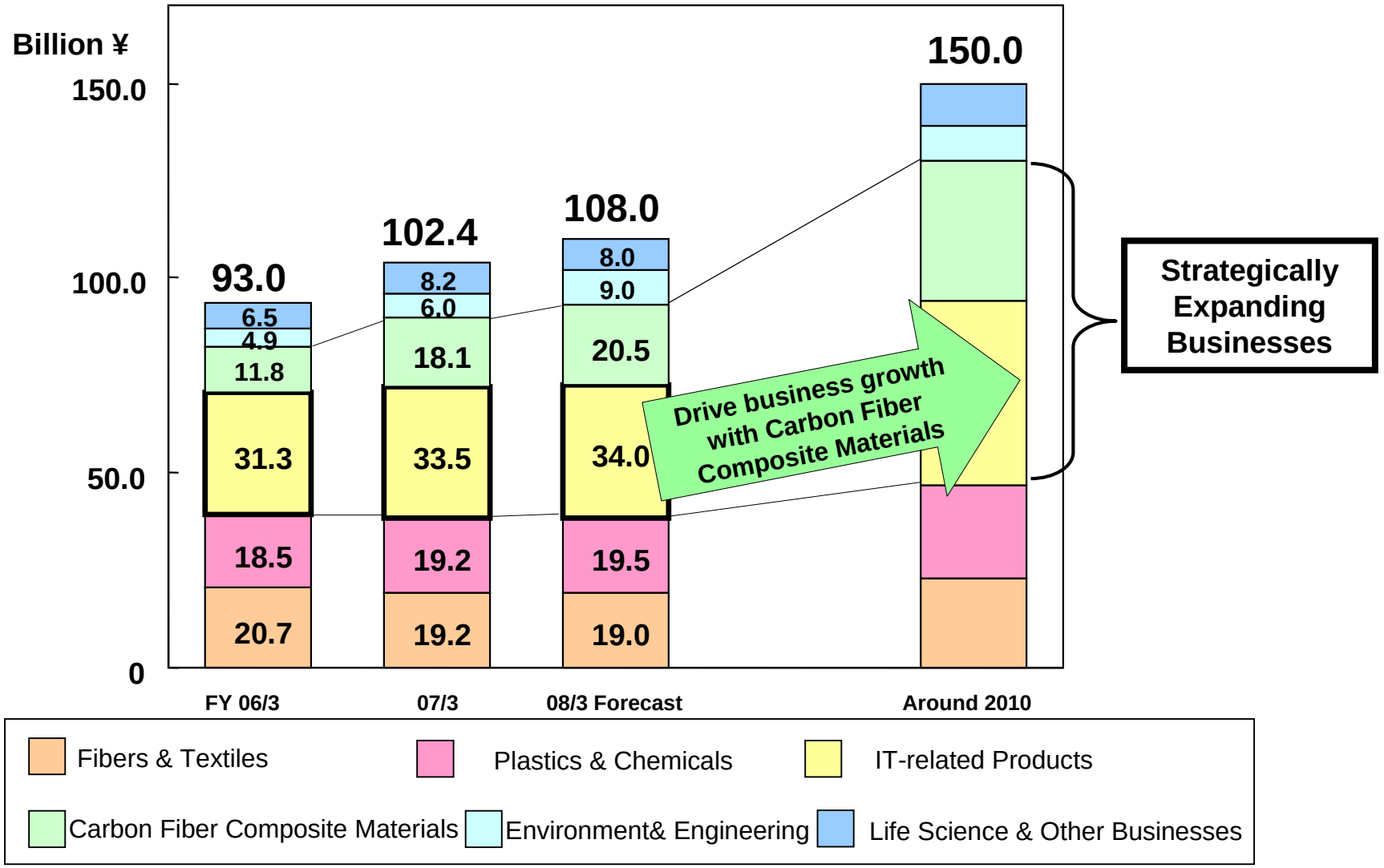


# Expansion Strategies for IT-related Products




**In order to secure further growth as a leader in the promising IT area, Toray Group will not just "deal" but cultivate "engagement" with influential customers in the supply chain**

# Trends in Operating Income by Business Segment




**In addition to further expansion of existing businesses, Toray will accelerate earnings growth through commercialization of new advanced materials business**

**Description of predicted business results, projections, and business plans contained, in this material are based on predictive forecasts of the future business environment made at the present time.**

**The material in this presentation is not a guarantee of the company's future business performance.**