
# Business Strategy for IT-related Chemicals Sector

**September 1, 2016**

SUMITOMO CHEMICAL

Toshihisa Deguchi
IT-related Chemicals Sector,
Representative Director &
Senior Managing
Executive Officer

# Contents

*Create New Value*

# Contents

*Create New Value*

# Business Overview of IT-related Chemicals

*Create New Value*

Flat Panel Display Materials

Color filters

Touchscreen panels

Polarizing films

Photo spacers

Overcoat agents

Light diffusion plates

Cleaning chemicals

Processing chemicals for LCD panels (etchant, stripper)

Materials

Color resists

Photoresists (upstream process)

Aluminum targets

Light guide plates

Sapphire

Thick i-line resists (downstream process)

Processing chemicals for semiconductors (sulfuric acid, hydrogen peroxide solution, and others)

Semiconductor Materials

GaN substrates

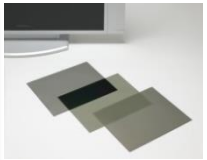
GaAs epiwafers

GaN epiwafers

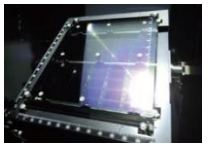
Others

Components

Compound Semiconductor Materials

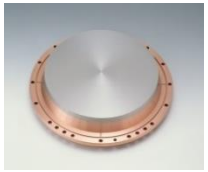


Polarizing films



Touchscreen panels

Photoresists



Aluminum targets

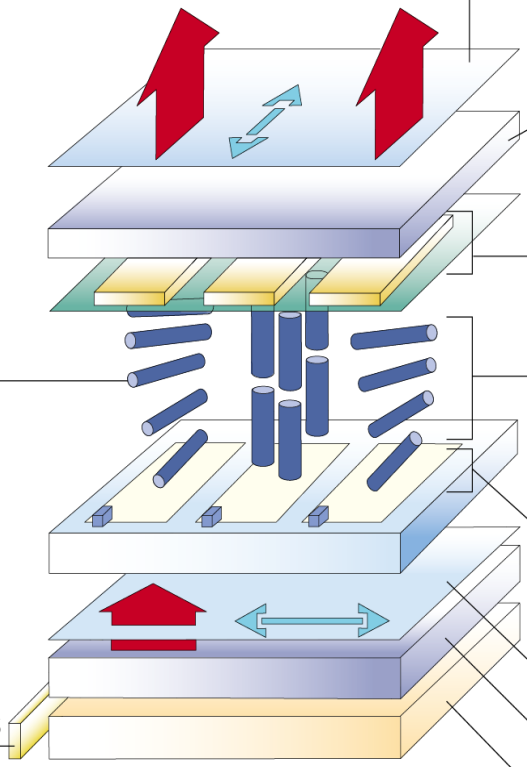
GaAs epiwafers

# Flat Panel Display Materials

Create New Value

## Sumitomo Chemical Products Used in LCD Panels

### Structure of Liquid Crystal Displays



- ●Polarizing film
- Glass substrate
- Color filter layer
  - ●Color filter
  - ●Color resist
  - ITO electrode
- Liquid crystals
- Liquid crystal layer
- TFT layer
  - ●Photoresists, Aluminum targets, Processing chemicals for LCD panels (Etchant, Stripper)
  - ITO electrode
- LED light source
  - ●Sapphire substrates
- ●Polarizing film
- ●Light diffusion plates
- ●Light guide plates

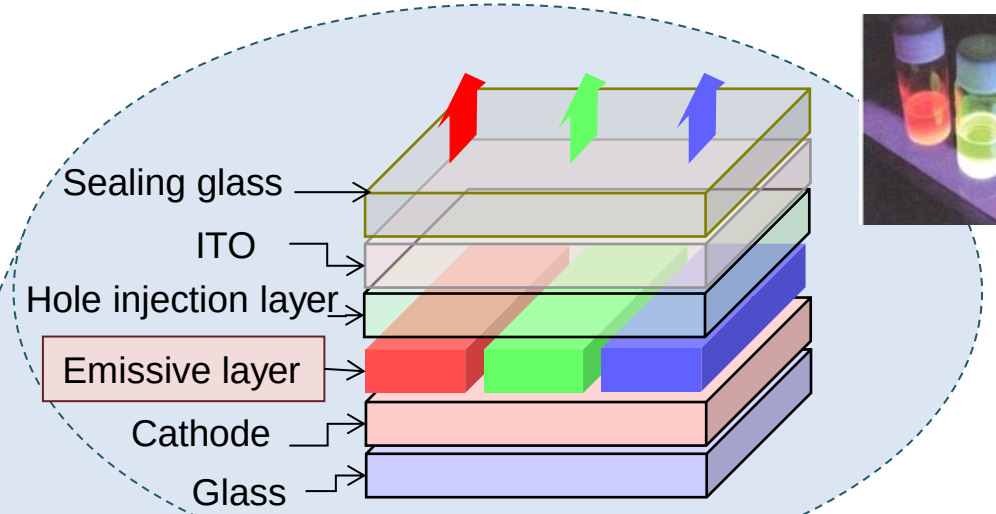
(Note)● : Indicates Sumitomo Chemical product

# Flat Panel Display Materials



## Sumitomo Chemicals Products Used in OLED Panels

### OLED display structure



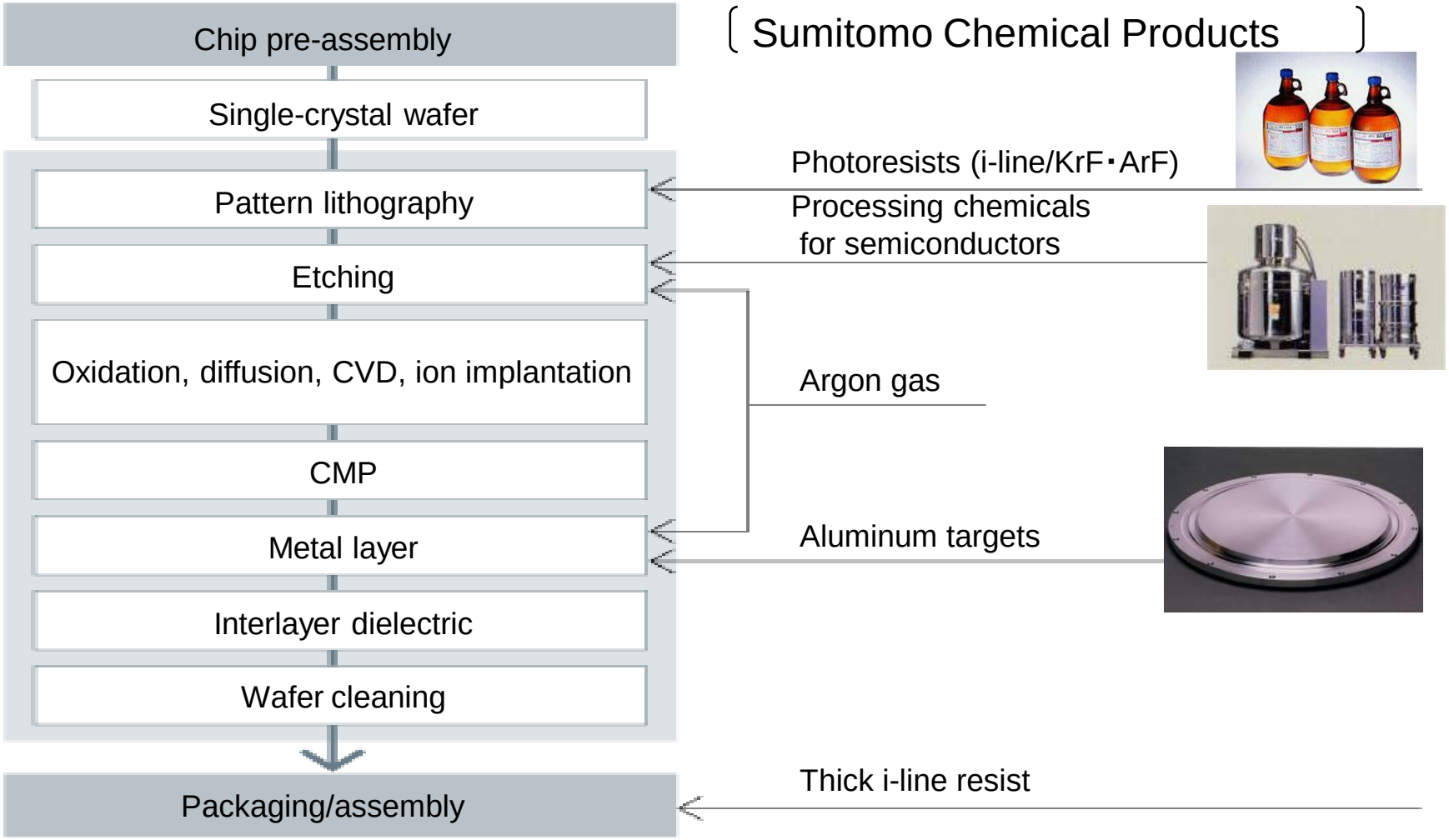

### Sumitomo Chemical's OLED-related materials

| OLED display structure | SC's materials (already on market) | SC's materials (under development) |
|---|---|---|
| Cover glass | | Window film |
| Polarizer | Polarizer | Liquid crystal coated polarizer |
| ITO (xy) | Touchscreen panel (TSP) | Flexible TSP |
| Sealing glass | | PLED light-emitting materials |
| OLED | | Barrier film |
| Glass | | |

# Semiconductor Materials



## Sumitomo Chemical Products Used in Semiconductor Chip Manufacturing



# Compound Semiconductor Materials



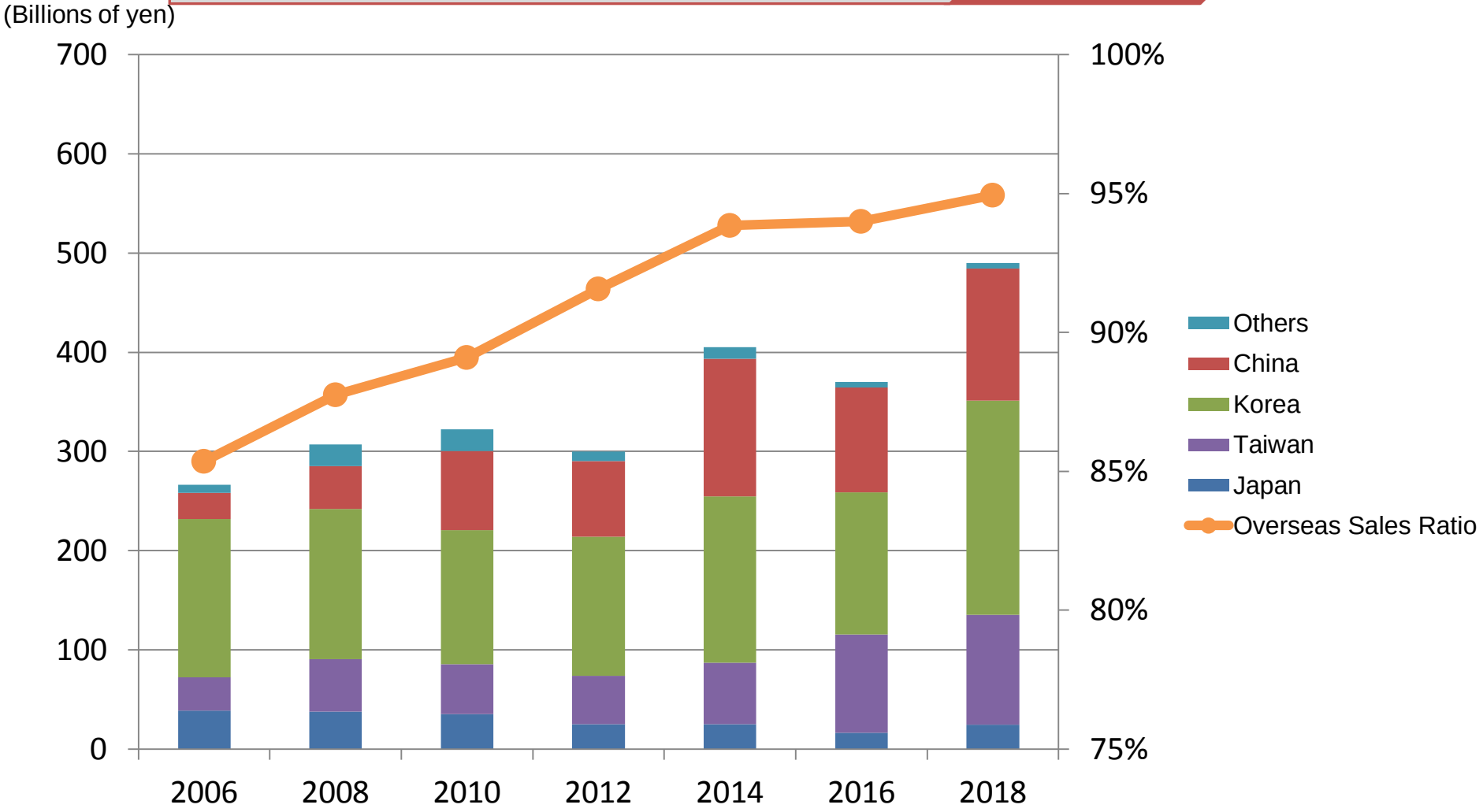
## Sumitomo Chemical compound semiconductor materials

| Products | | Applications |
|---|---|---|
| Existing products | GaAs epiwafers | Smartphone switches and amps, LEDs |
|  | GaN substrates | Blue semiconductor lasers, high-luminance LEDs and power devices |
| | GaN-on-SiC epiwafers | High-output high-frequency devices (for radars and communication base stations) |
| Next-generation products | GaN-on-Si epiwafers | Power devices (household electrical appliances and IT equipment) |
|  | GaN-on-GaN epiwafers | Power devices (trains, cars, and electricity transmission and distribution) |

# Consolidated Sales

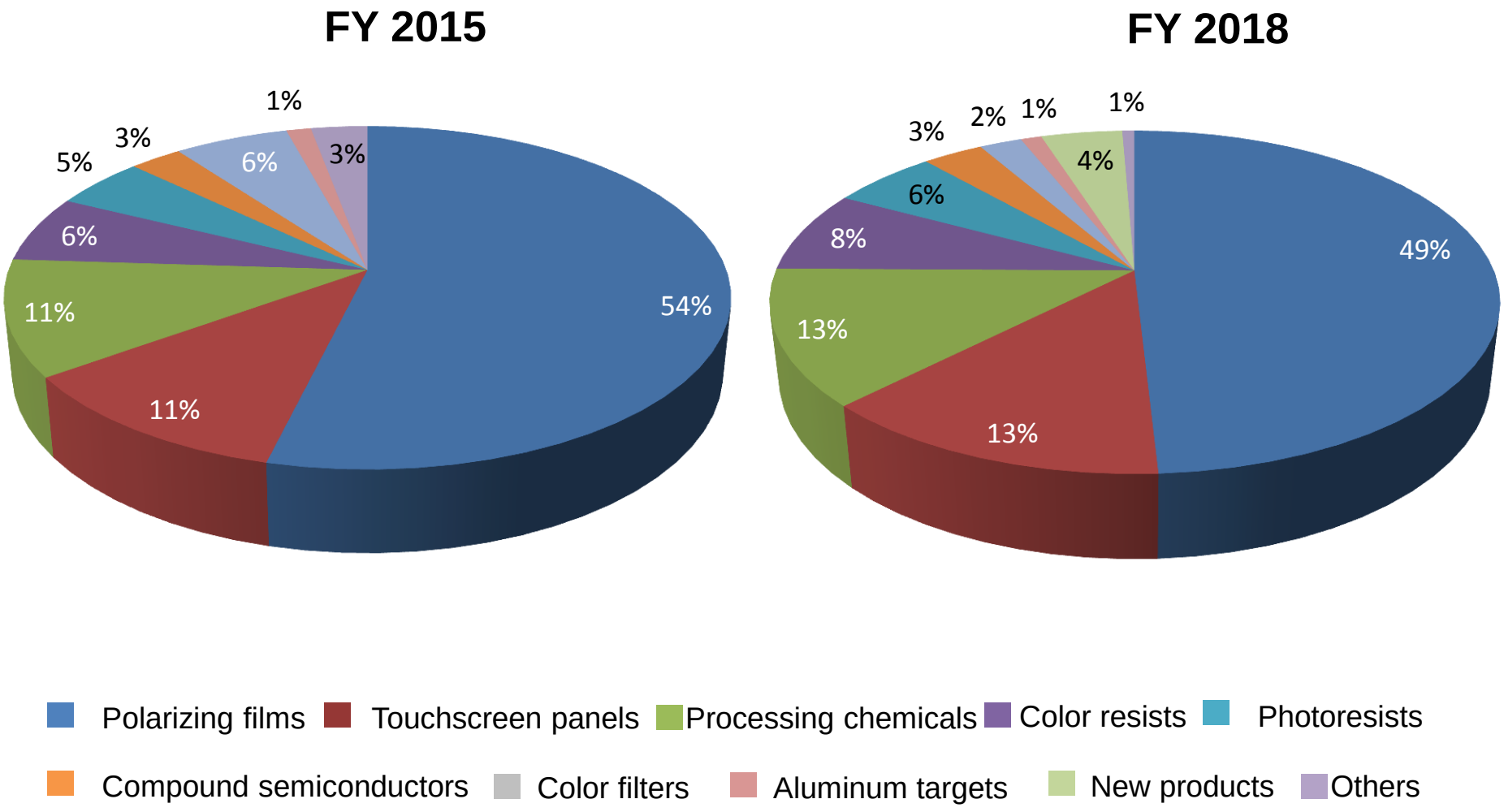
*Create New Value*

Before change in business portfolio | After change



# Sales by Product Portfolio

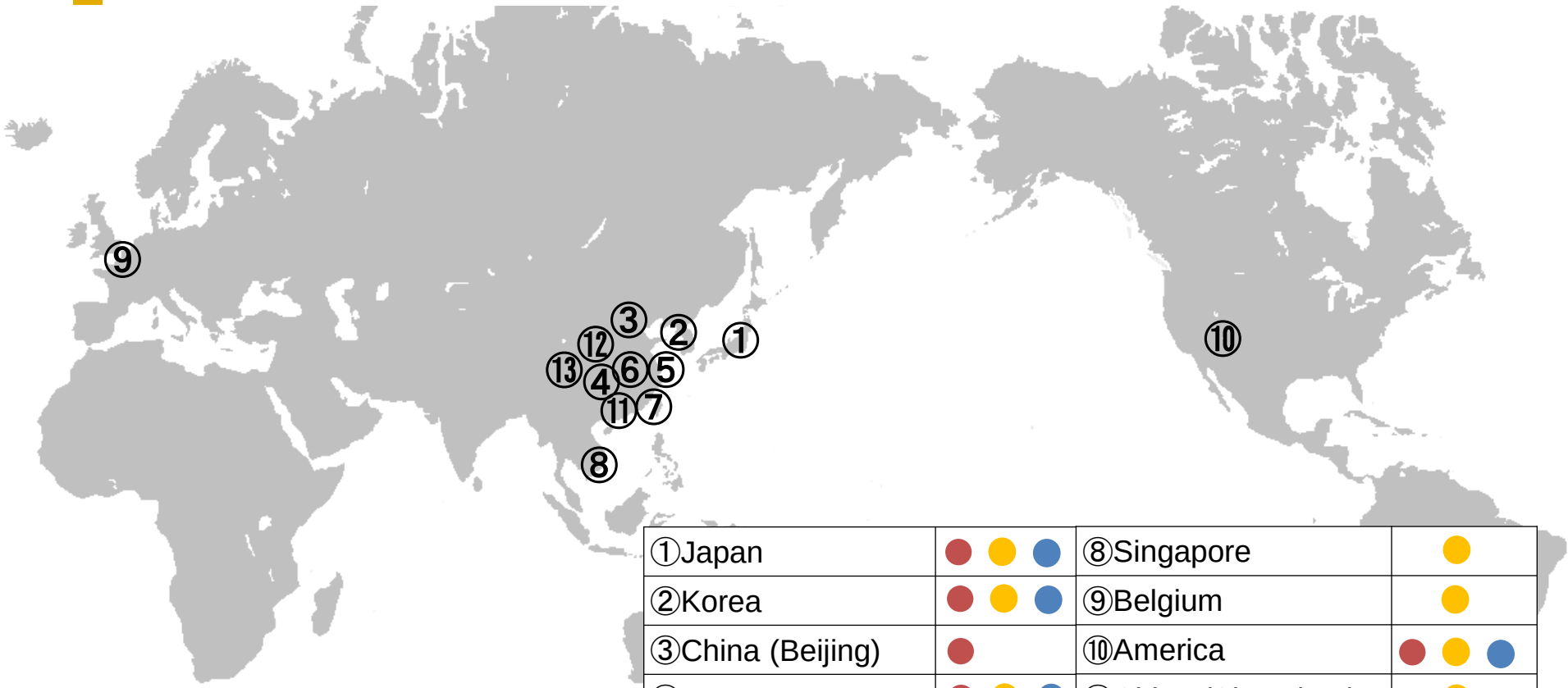
*Create New Value*



# Our Market Needs-Driven Global Supply Chain

*Create New Value*

## Overseas Operations




| | | | |
|---|---|---|---|
| ①Japan | ● ● ● | ⑧Singapore | ● |
| ②Korea | ● ● ● | ⑨Belgium | ● |
| ③China (Beijing) | ● | ⑩America | ● ● ● |
| ④China (Hefei) | ● ● ● | ⑪China (Shenzhen) | ● |
| ⑤China (Shanghai) | ● ● | ⑫China (Xi'an) | ● ● |
| ⑥China (Wuxi) | ● | ⑬China (Chongqing) | ● ● |
| ⑦Taiwan | ● ● ● | | |

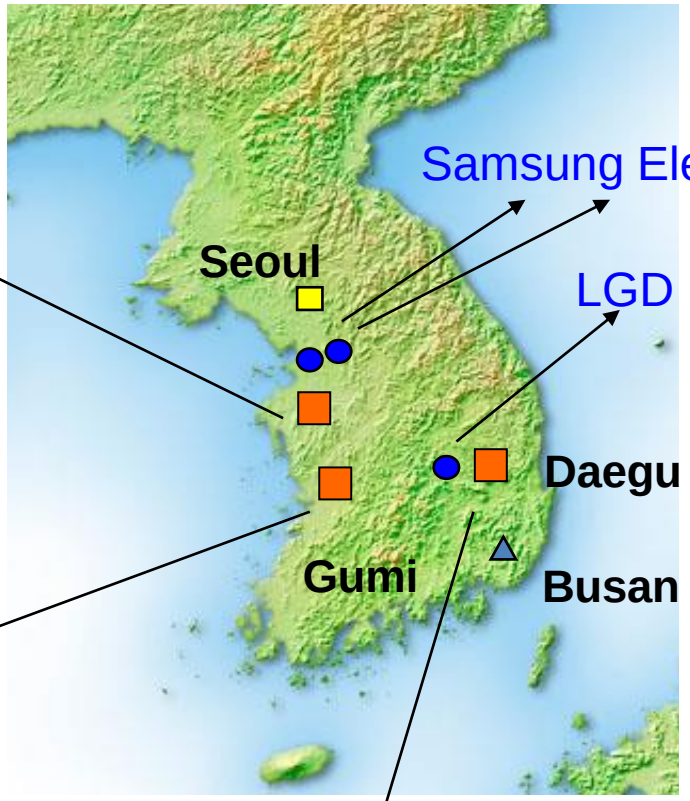
● **Production plants**
● **Sales offices**
● **R&D labs**

# Our Business in Korea

*Create New Value*

**Our business facilities**

**Customers' business facilities**




### ◆Pyongtaek

- **Dongwoo Fine-Chem Co., Ltd. (Head office/Plant/Research laboratory)**
  - Polarizing films
  - Touchscreen panels
  - Color filters
  - Processing chemicals for LCD panels and semiconductors
  - Color resists

### ◆Iksan

- **Dongwoo Fine-Chem Co., Ltd. (Plant/Research laboratory)**
  - Processing chemicals for LCD panels, semiconductors
  - (- High-purity alumina)

### ◆Daegu

- **SSLM Co., Ltd. (Head office/ Plant)**
  - Sapphire substrates
  - (- Separators)

**Sales: 225 billion yen (FY2015)**

**Number of employees: 3,132 (end of FY2015)**

# Our Business in Taiwan



**Our business facilities**

**Customers' business facilities**

## ◆ Hsinchu

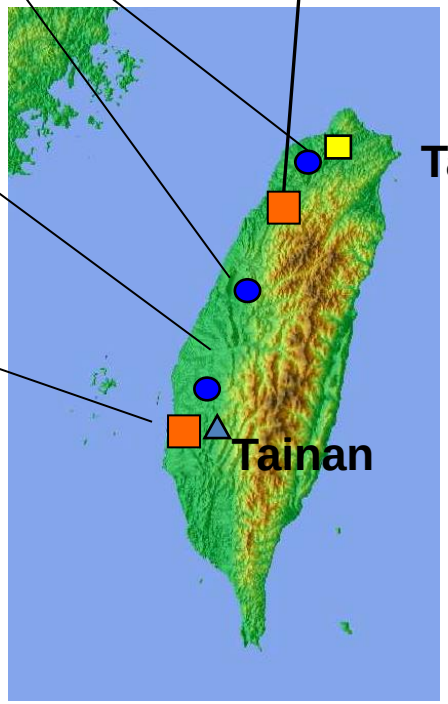
- **Sumika Technology Co., Ltd. (Plant)**
  - **Color filters**

Innolux Corporation

AU Optronics

## ◆ Tainan

- **Sumika Technology Co., Ltd. (Head office/Plant/Research laboratory)**
  - **Polarizing films**
  - **Aluminum targets**
  - **Color resists**
  - **Ink jet printing light-guide plate(LGP)**



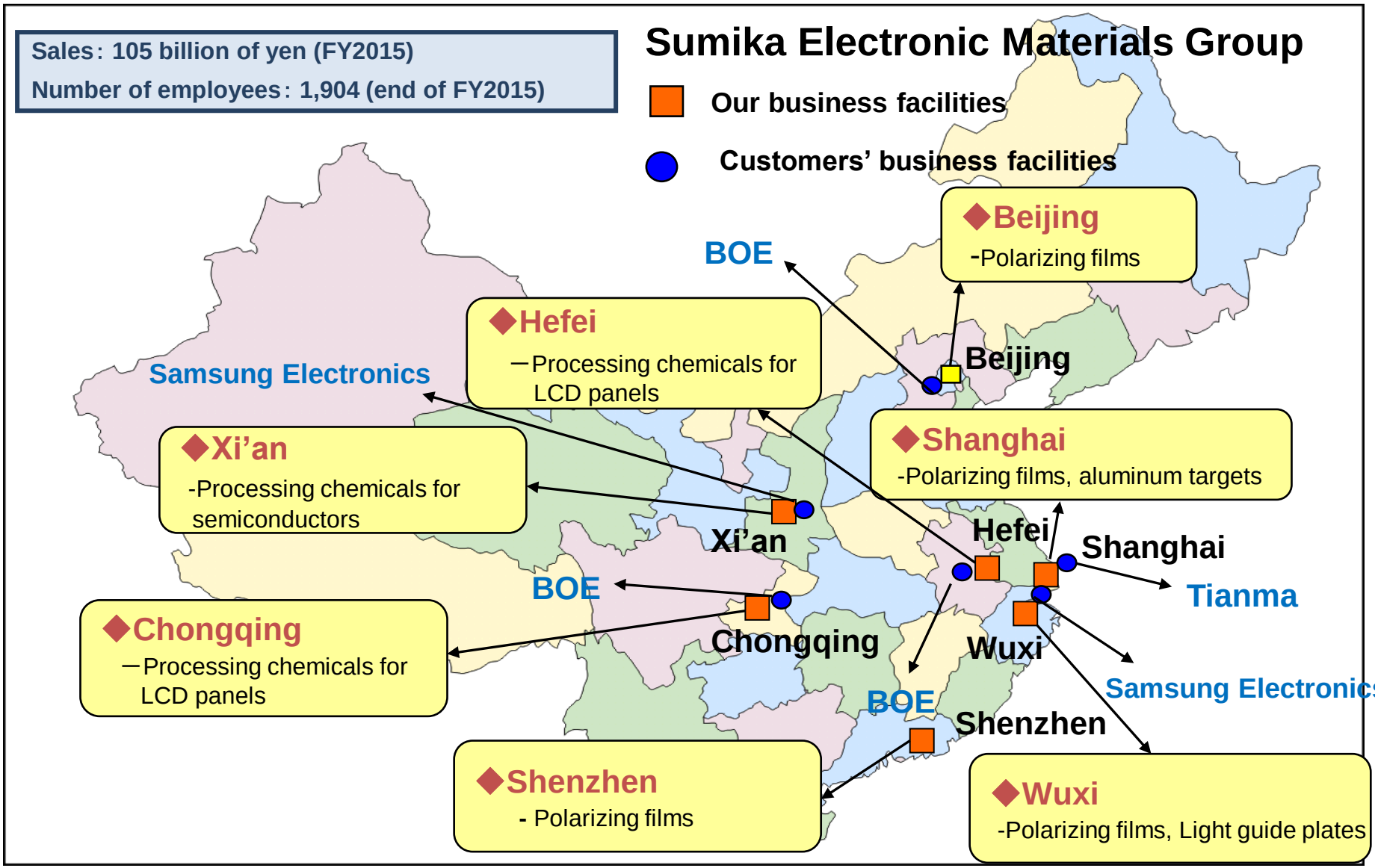

**Sales: 100 billion yen (FY2015)**

**Number of employees: 2,467 (end of FY2015)**

# Our Business in China

*Create New Value*

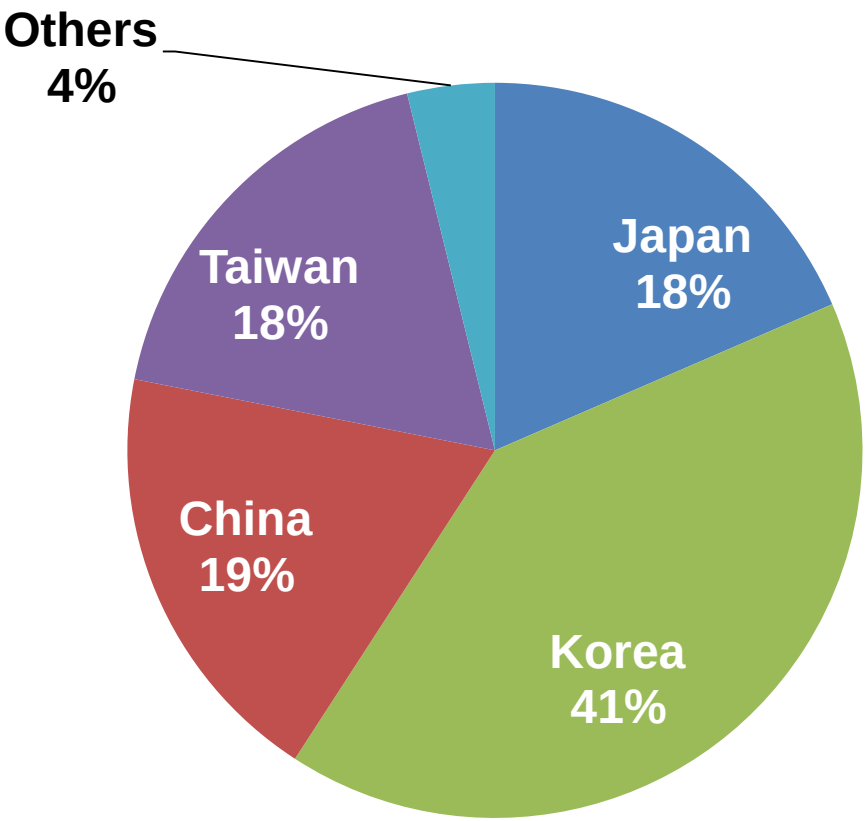
**Sales: 105 billion of yen (FY2015)**
**Number of employees: 1,904 (end of FY2015)**



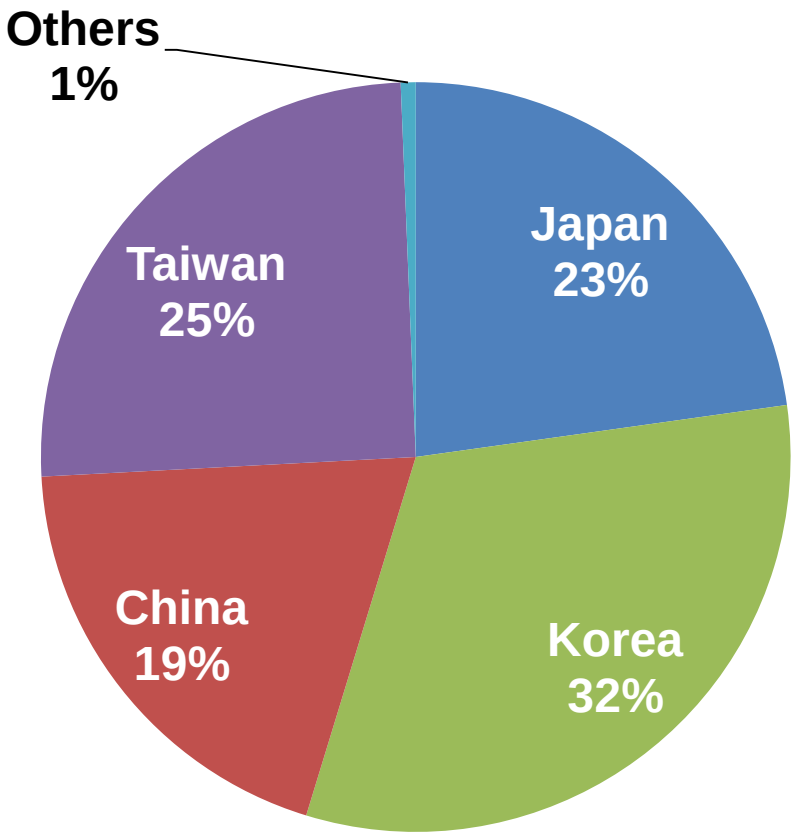
# Current Status of Our Global Business

*Create New Value*

## Sales by country (FY2015)




## Number of employees by country (as of end of FY2015)



# Contents

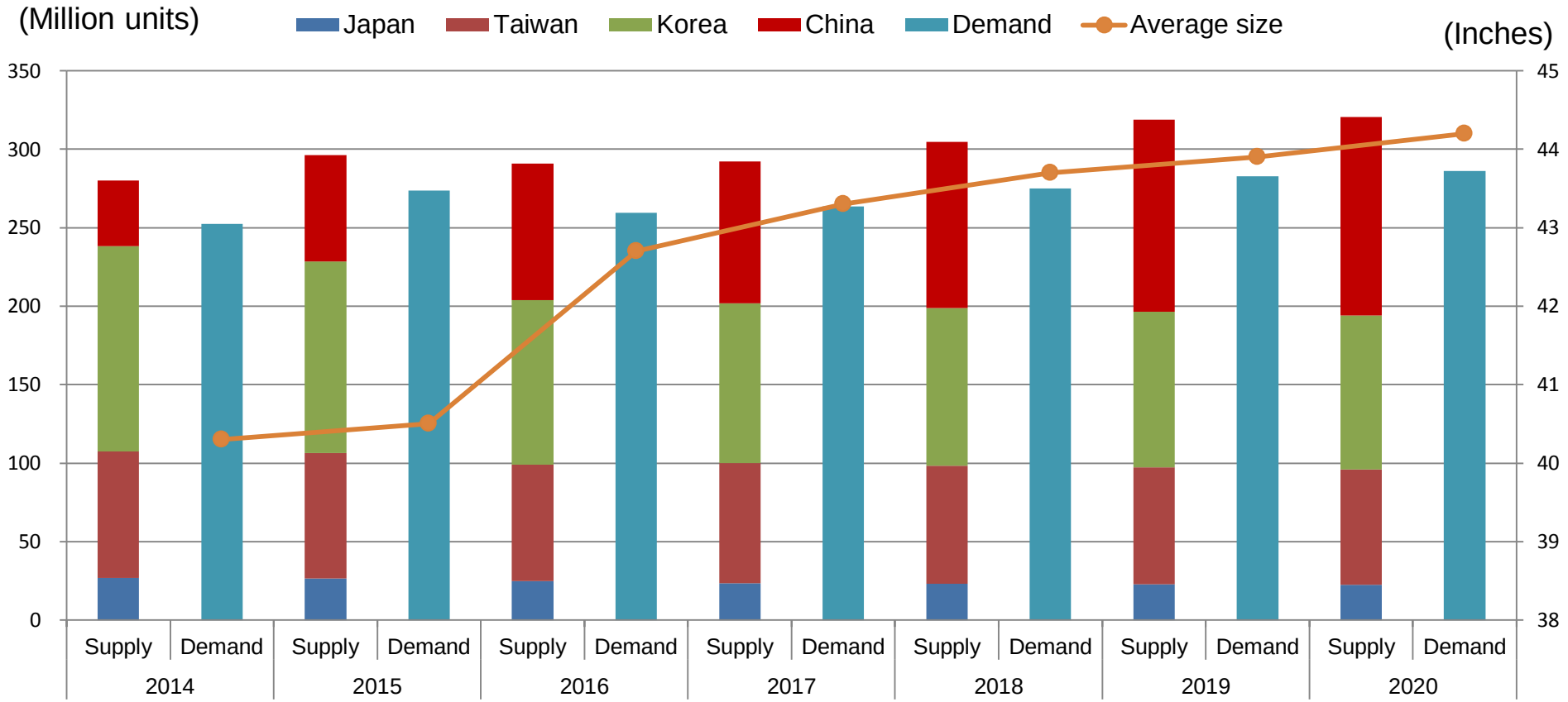
*Create New Value*

# Flat Panel Display Materials Market

Create New Value

## LCDs for the TV market

### Demand and production capacity for LCD panels for TVs by country




(Source: IHS Technology (DisplaySearch))

# Flat Panel Display Materials Market



## LCDs for the TV market

**Chinese panel makers' investment plans from 2017**

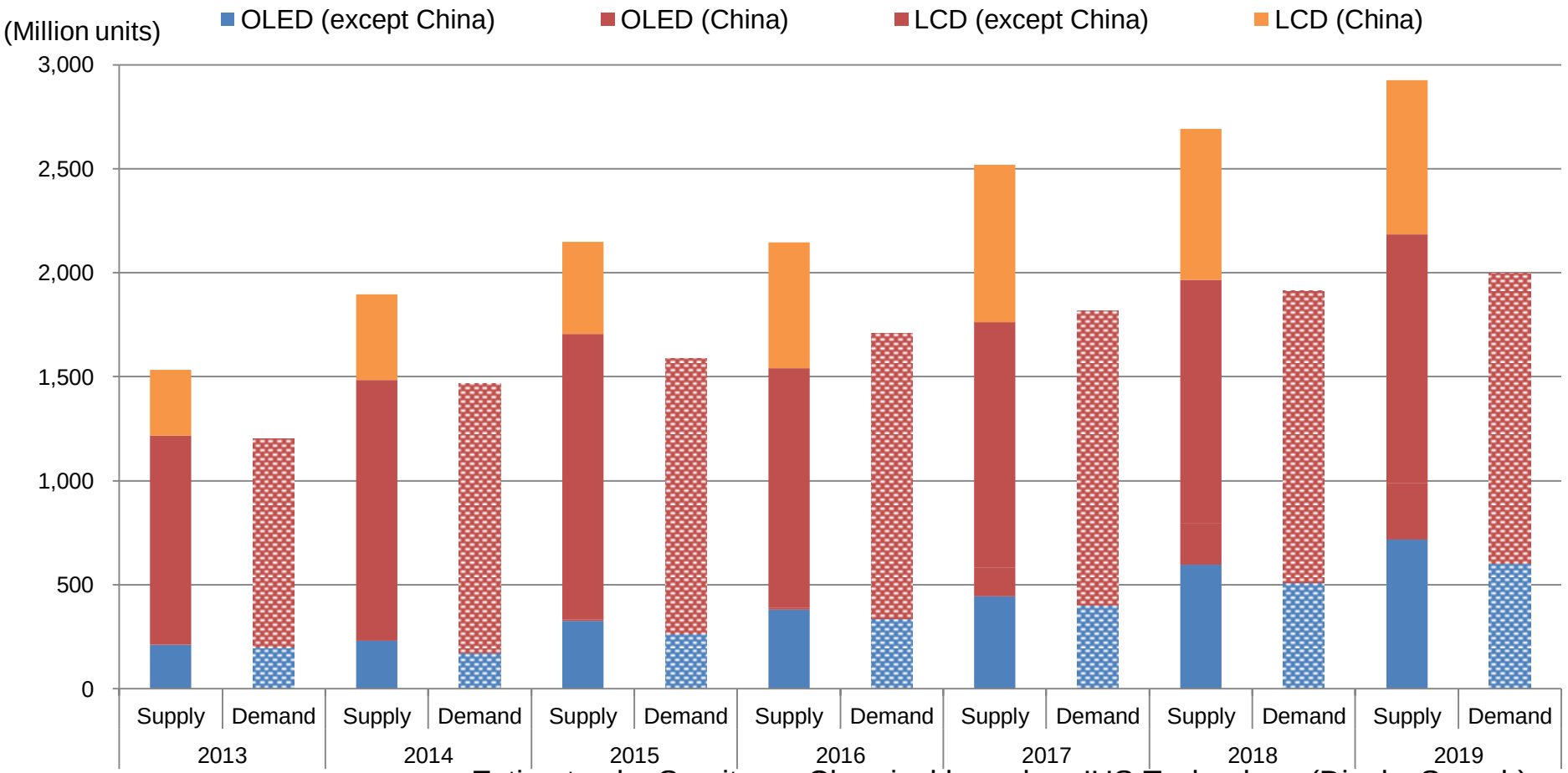
| Start of Operation | Company | Line | Location | Generation | Capacity (thousands/month) |
|---|---|---|---|---|---|
| Q3 2017 | BOE | B10 | Fuzhou | 8.5 | 120 |
| | HKC | — | Chongqing | 8.6 | 70 |
| Q2 2018 | BOE | B9 | Hefei | 10.5 | 90 |
| 2018 | BOE | B11 | Mianyang | 8.5 | 120 |
| | CEC IRICO | — | Xianyang | 8.6 | 60 |
| Q2 2019 | CSOT | T6 | Guangzhou | 10.5 | 90 |

# Flat Panel Display Materials Market



## Displays for the mobile devices market

### Demand and production capacity for displays for mobile devices




Estimates by Sumitomo Chemical based on IHS Technology (DisplaySearch)

# Flat Panel Display Materials Market



## Displays for the mobile devices market

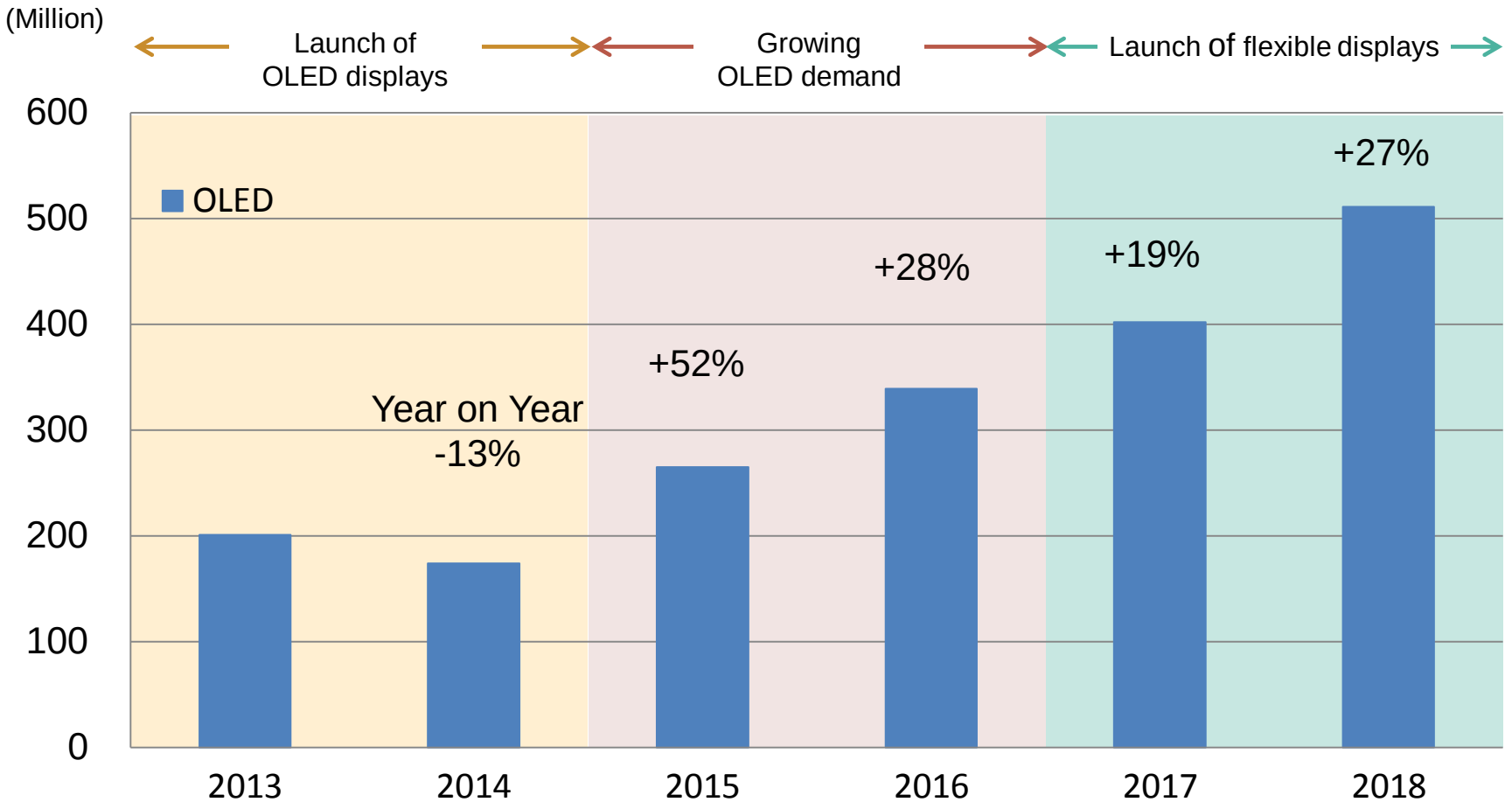
**Investment plans for production facilities for smartphone LCD/OLED displays**

| Start of Operation | Company | Country | Technology | Generation | Capacity (thousands/month) |
|---|---|---|---|---|---|
| Q3 2016 | JDI | Japan | LTPS/LTPO | 6 | 50 |
| | INX | Taiwan | LTPS | 6 | 24 |
| Q4 2016 | Tianma | China | LTPS | 6 | 30 |
| | SDC | Korea | **OLED** | 6 | 30 |
| 2016 | TCL | China | LTPS | 6 | 60 |
| Q1 2017 | TCL | China | **OLED** | 6 | 60 |
| | Tianma | China | **OLED** | 6 | 30 |
| | FVO | China | LTPS | 6 | 30 |
| | SDC | Korea | **OLED** | 6 | 30 |
| | LGD | Korea | **OLED** | 6 | 10 |
| Q2 2017 | SDC | Korea | **OLED** | 6 | 30 |
| | LGD | Korea | **OLED** | 6 | 25 |
| Q3 2017 | BOE | China | **OLED** | 6 | 45 |
| Q4 2017 | Tianma | China | **OLED** | 6 | 30 |
| | JDI | Japan | **OLED** | 6 | 25 |
| | LGD | Korea | **OLED** | 6 | 50 |
| 2018 | Hon Hai | China | LTPS/**OLED** | 6 | 60 |

# Flat Panel Display Materials Market

Create New Value

## Smartphone OLED displays market

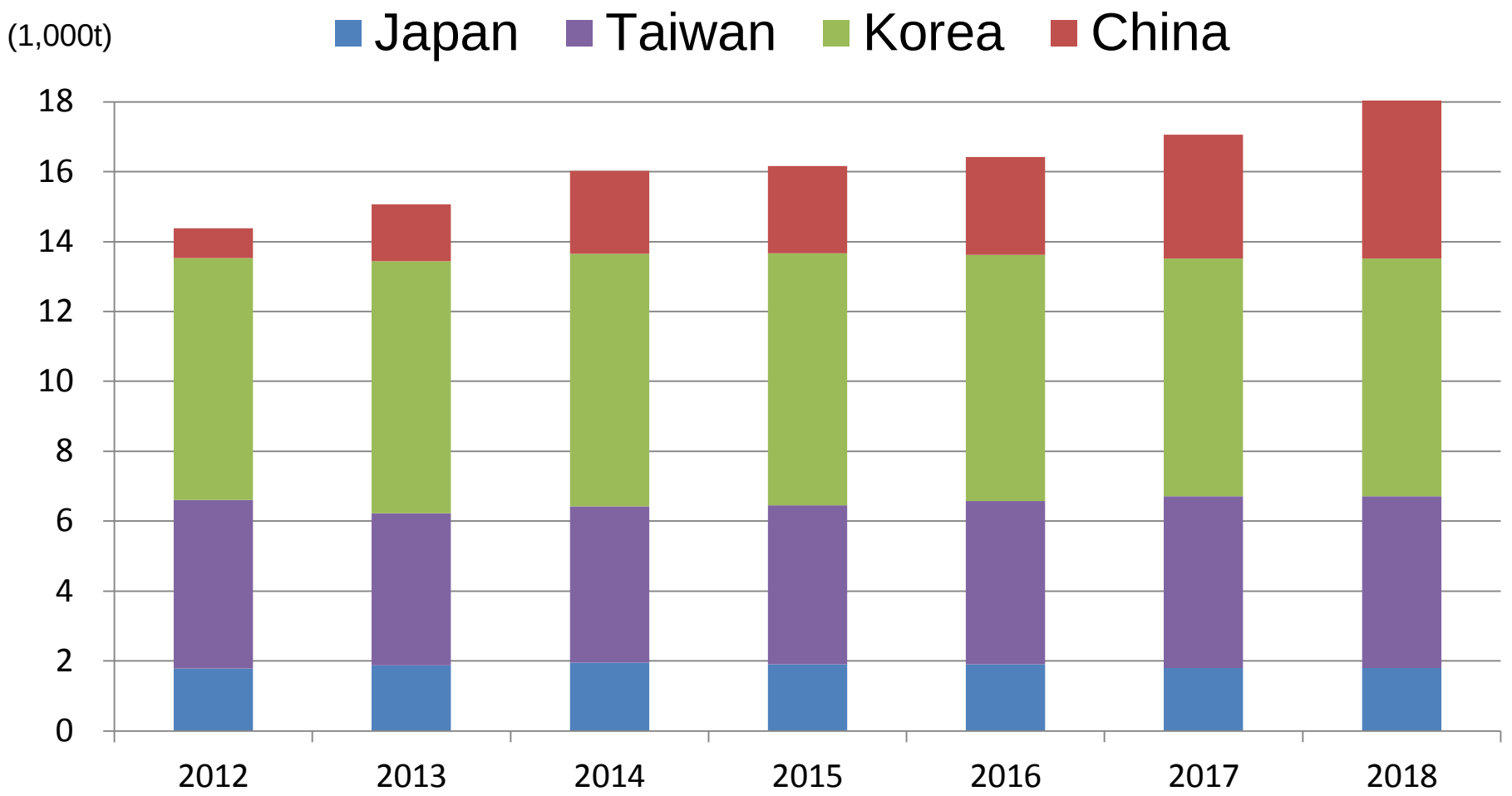



(Source: IHS Technology (DisplaySearch))

# Flat Panel Display Materials Market



## Color resists market




*Sumitomo Chemical estimations

# Flat Panel Display Materials Market

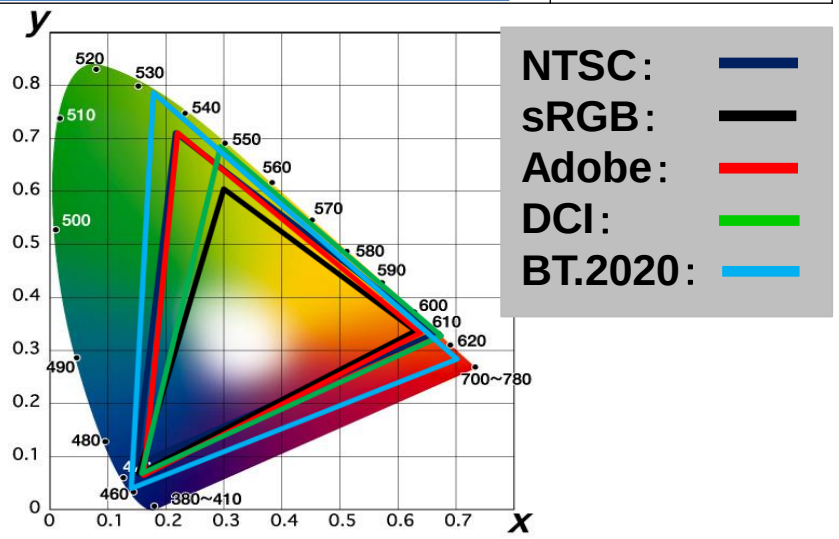


## Required properties for liquid crystal displays and color resists

| Required properties for liquid crystal displays | Technology trends | | | | | | Required Properties for color resists |
|---|---|---|---|---|---|---|---|
| Higher color reproduction | ①LCD Panel standards | NTSC/72% =s-RGB | ⇒ | DCI/ adobe | ⇒ | UHDTV (BT2020) | Deeper colors |
| Greater brightness | ②Backlights | (White) LEDs | ⇒ | 3 wavelength backlights | ⇒ | Laser backlights | High transmittance |
| Higher definition | ③Image resolution | (TV) | 2K | ⇒ | 4K | ⇒ | 8K | High resolution |
| | | (Mobile) | 600ppi | ⇒ | 800ppi | | |

### Requirement for color resists

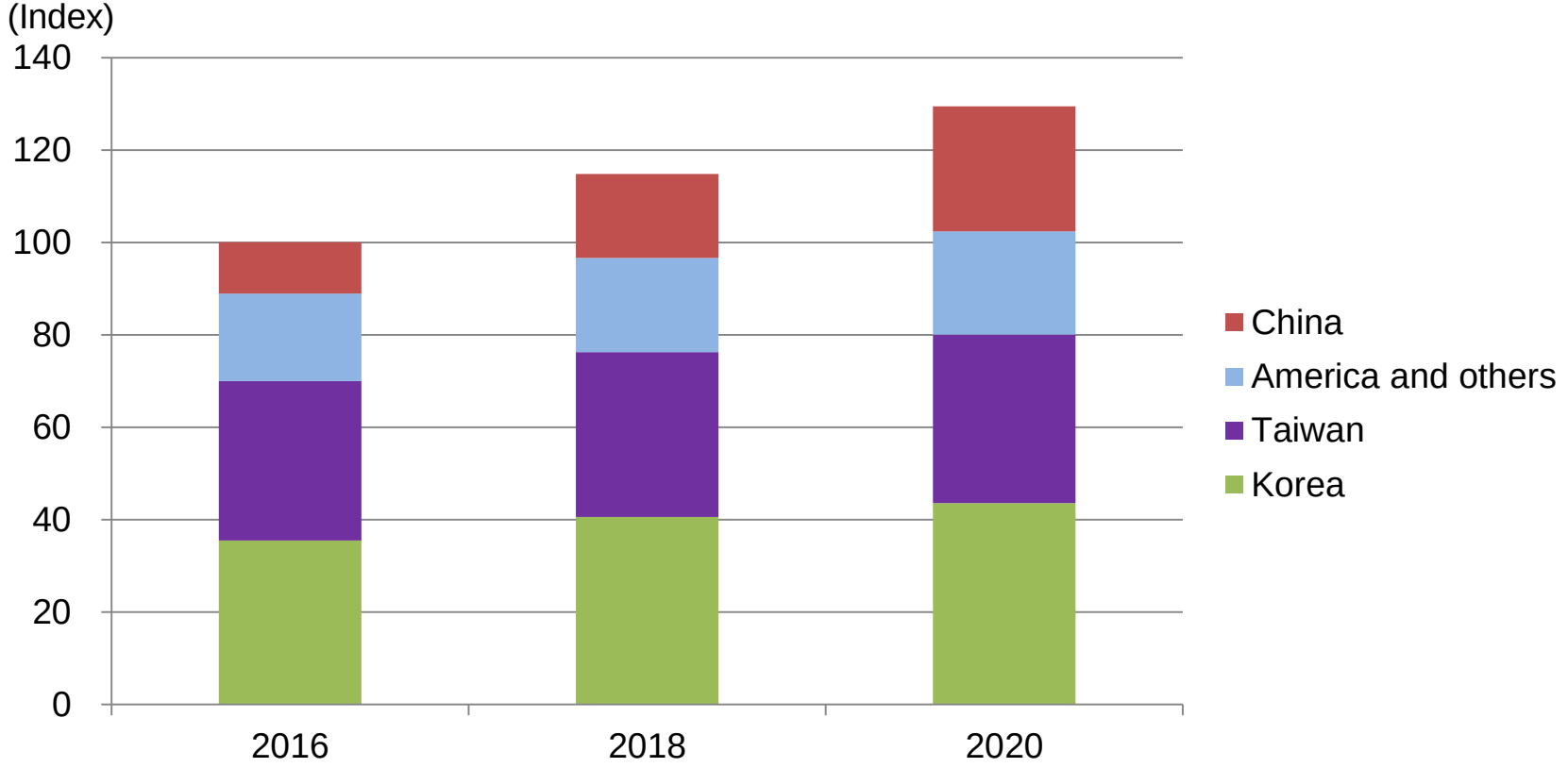
1. High resolution resin that can provide high definition displays.
2. Color material that has both a high transmittance and deeper colors, even with a thin layer.



# Semiconductor Materials Market



## Main semiconductor manufacturing capacity forecast by region (12 inch plant)




## Trends in miniaturization of circuits

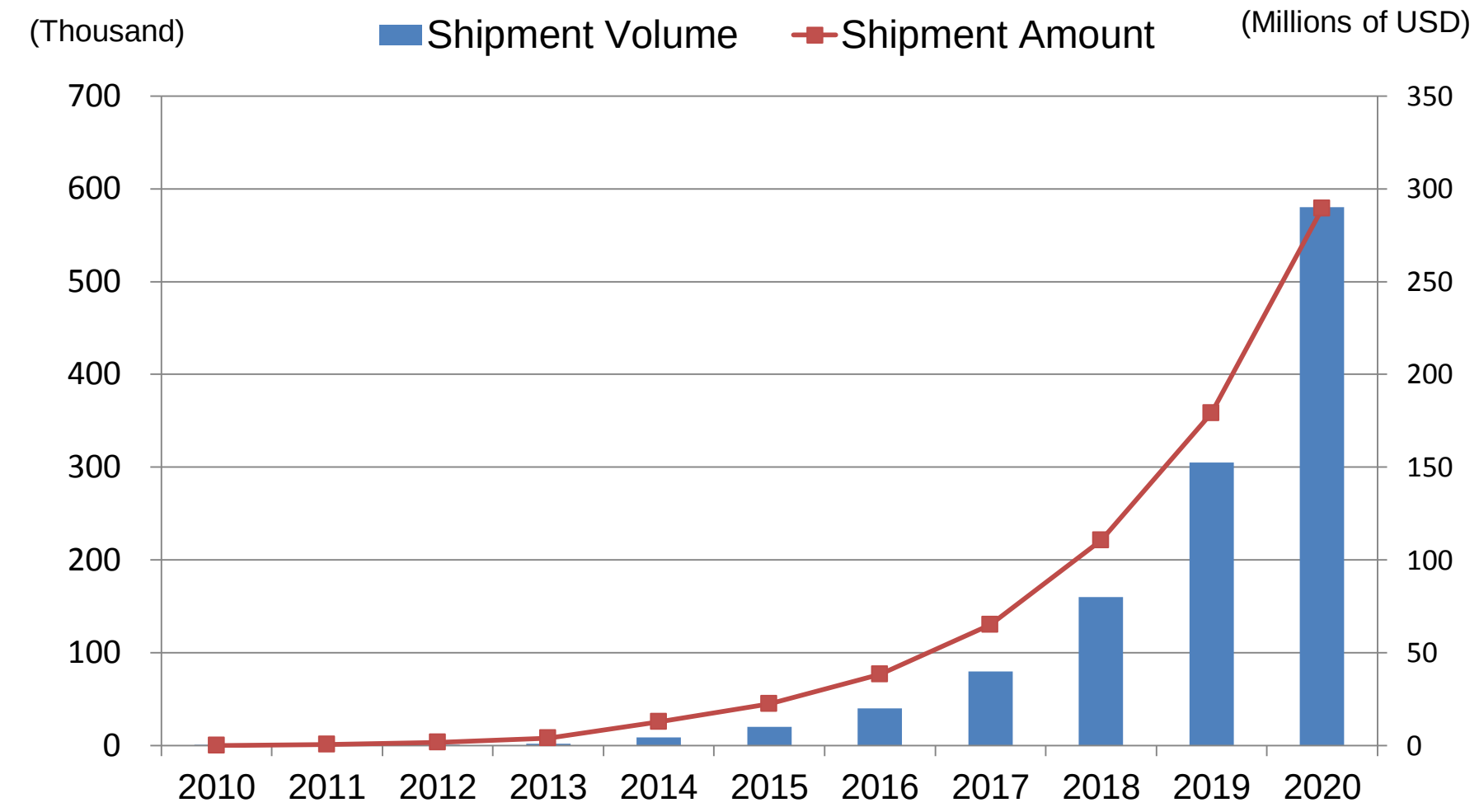
| | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|
| DRAM | 20nm | 1Xnm | 1Ynm | 1Znm |
| LSI | 14-16nm | 10nm | 7nm | |

*Sumitomo Chemical estimations

# Compound Semiconductor Market

Create New Value

## Power devices market (GaN-on-Si)



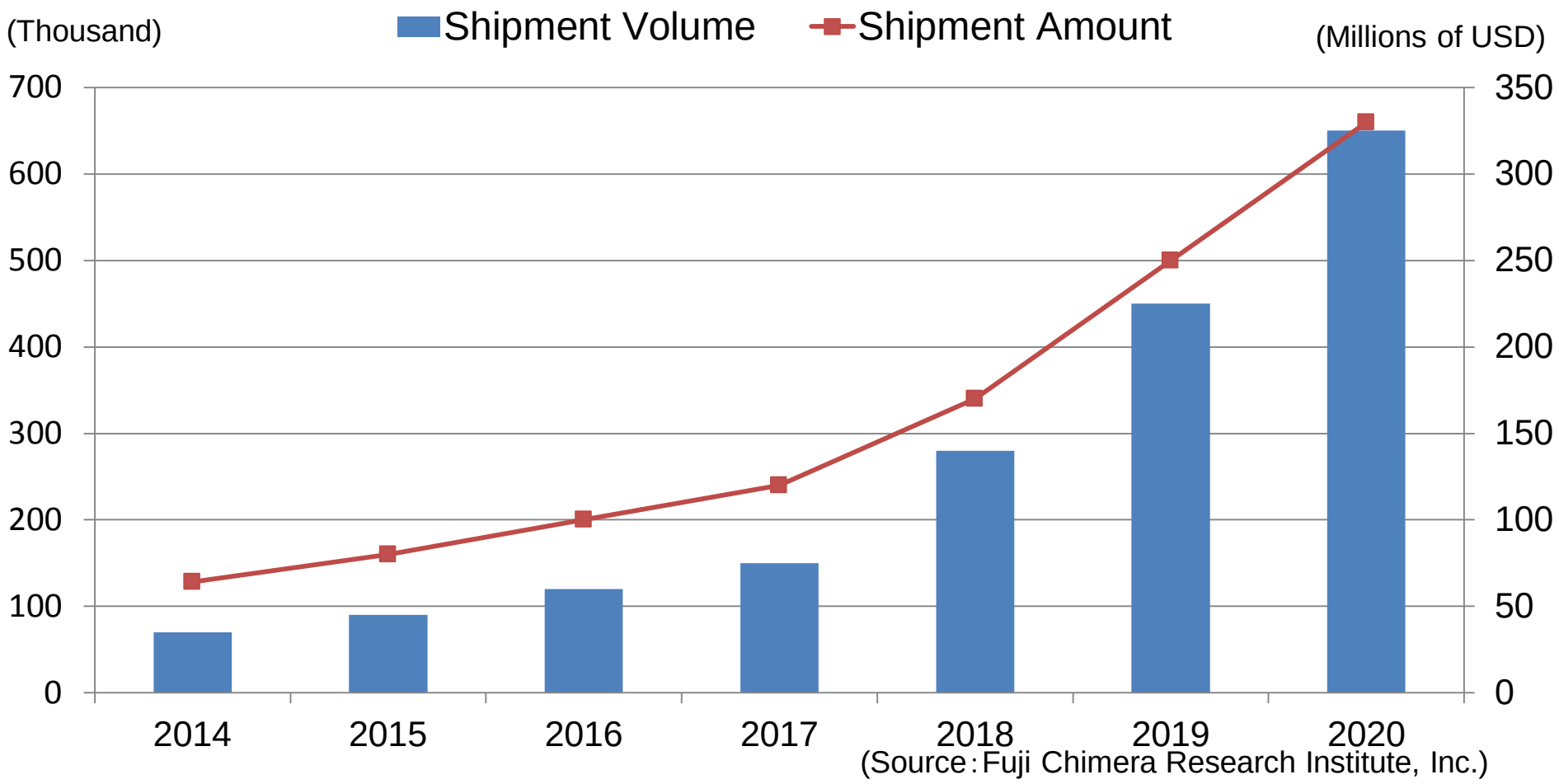

(in terms of 6-inch product)

(Source : Yole Développement)

# Compound Semiconductor Market



## GaN substrates market



# Contents

*Create New Value*

# Medium to Long-term Vision for IT-related Chemicals Sector

*Create New Value*

**Medium to long-term goal**

Deliver new value that responds to the changes in the ICT industry by leveraging our material development capabilities in collaborative development with customers

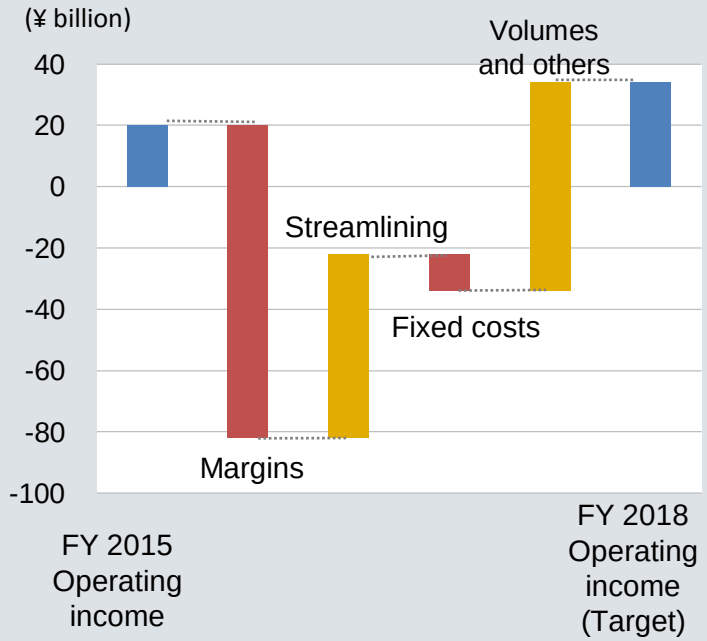
## Action plan

- Secure sustainability of the polarizer business
- Expand the touch sensor business
- Expand the semiconductor materials business
- Develop a new core business in addition to the polarizer and touchscreen businesses

**FY2018 Target**

| | |
|---|---|
| Net sales | ¥490.0 billion |
| Operating income | ¥34.0 billion |

Operating income variance analysis (FY2015 v/s FY2018)



# Flat Panel Display Materials



## Polarizing films for TV

**Market Environment**

- Commoditization of technology
- Maturation of the market
- Chinese LCD makers rushing to build new facilities

**Pressure to lower prices**

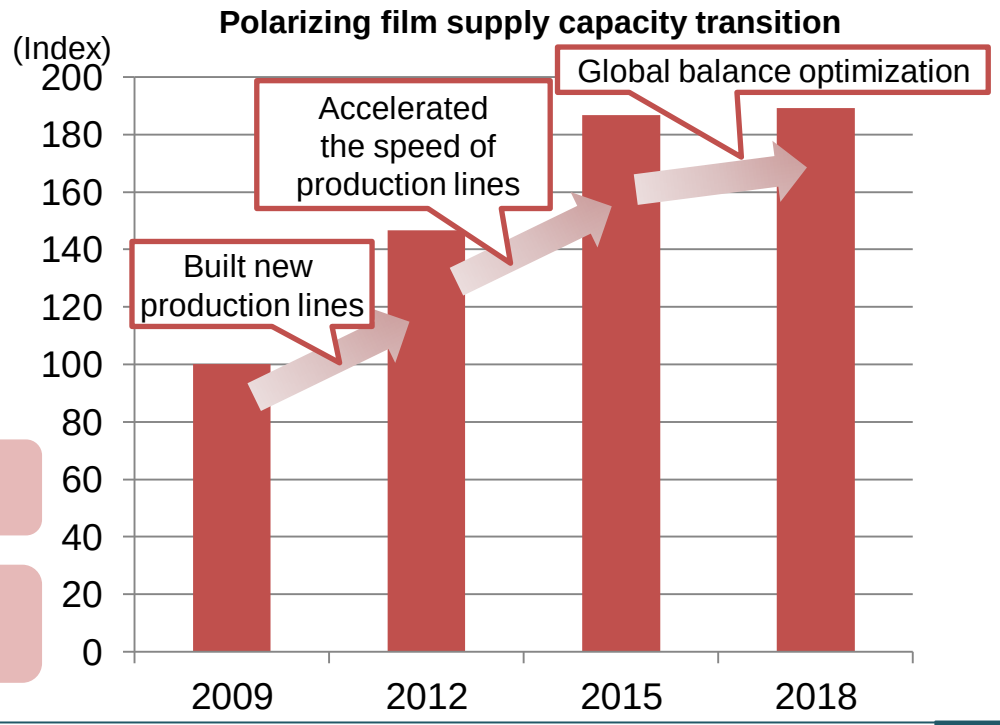
**Slight increase in panel demand**

**Basic Strategy**

- Global balance optimization
- Promoting thorough cost rationalization

**Maximize use of existing resources**

**Increased sales of products using in-house produced materials**



# Flat Panel Display Materials

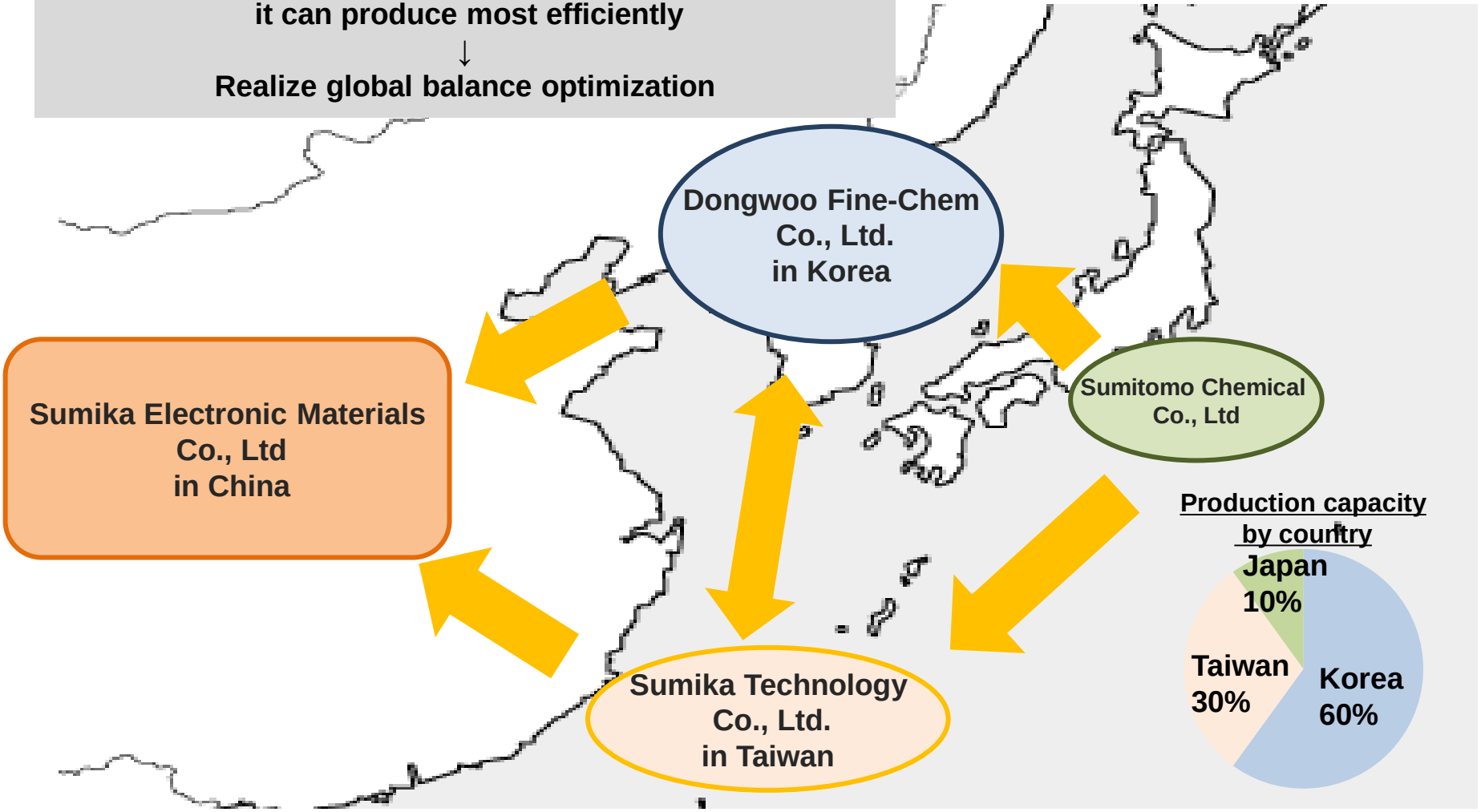


## Polarizing films for TV

**Each production line focuses on producing products it can produce most efficiently**

↓

**Realize global balance optimization**



# Flat Panel Display Materials

*Create New Value*

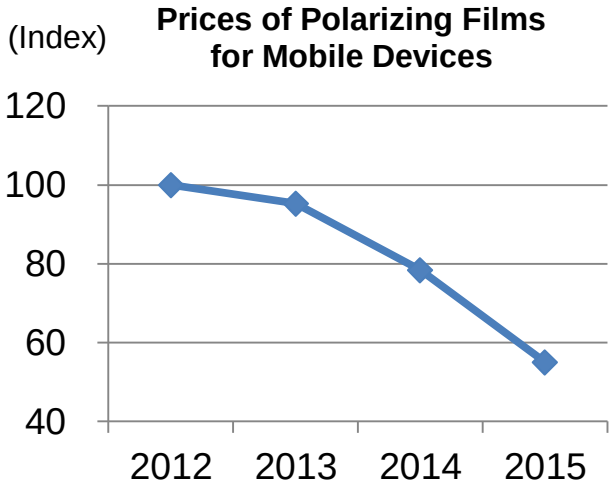
## Polarizing films for mobile devices

### Market Environment

- LCD panel oversupply
- Market maturation
- Rise of Chinese brands
- Growth of OLED panels

**Increased competition, reduced prices**

**OLED market expansion gathers steam**




### Basic Strategy

◆ Utilize our broad technology lineup

**Entry into promising markets**

**Automotive applications**

**OLED-related materials**

**Ultrathin stretched polarizing film**
**High durability polarizing film**
**Special processing**
**Reverse wavelength dispersion film**
**Coated-type polarizer**

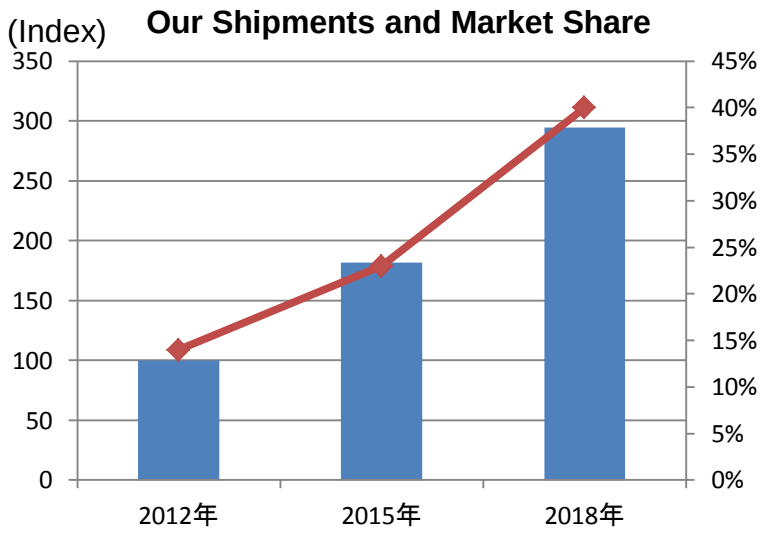
# Flat Panel Display Materials

*Create New Value*

## Color resists

### Market Environment

- Increased demand for high brightness/definition/color reproducibility
- Growth of the Chinese panel market




### Basic Strategy

- Differentiation through customization for different customers utilizing our superior dye development capabilities
- Enhance customer support in growth regions

**Accelerating the development of dye color resists**

**Global research targeted at the Chinese market, setting up a technical service structure**

**Track record of responding to customer needs in Taiwan and Korea**

**Accumulated technology from our dyes business**

# Flat Panel Display Materials

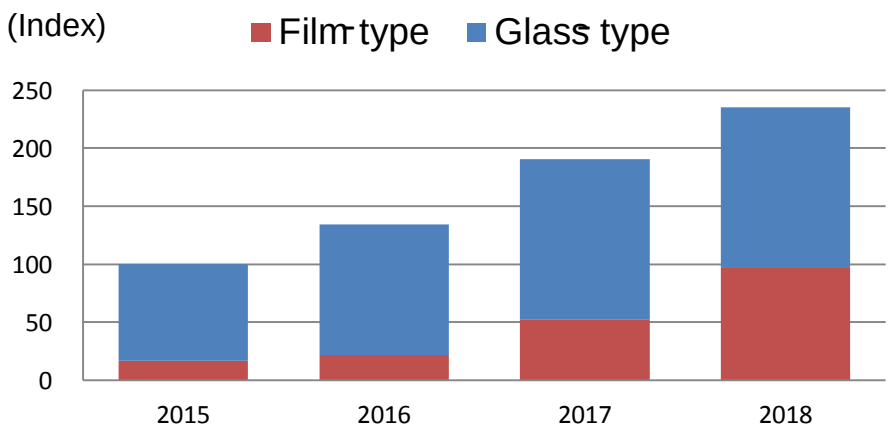
*Create New Value*

## Touchscreen panels (glass substrate and film substrate types)

**Market Environment**

- **Expanding market for OLED displays (increased demand for on-cell touch screen panels)**

**Production Capacity**




**Basic Strategy**

- Maintain top market share for on-cell type touchscreen panels
- Fully satisfy broad customer needs

**(Differentiation)**

- **Develop thinner glass-type touchscreen panels**
- **In-house processing of ITO layers**

**Increase customers for both glass substrate and film substrate types**

**Development capability of high-resolution products through differentiated technology**

**Development capability and cost competitiveness through in-house manufacturing of raw materials**

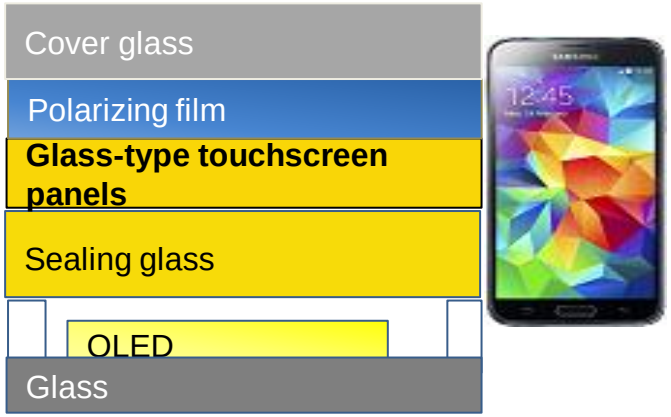
# Flat Panel Display Materials



## Touchscreen panels (glass and film types)

### Glass-type touchscreen panels

(Making sensors on sealing glass)

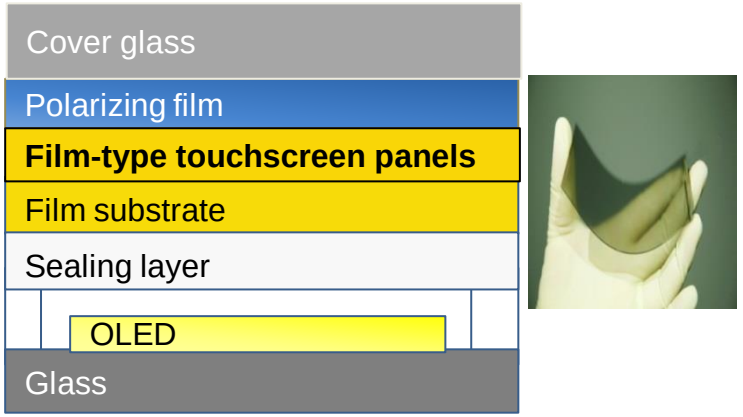



- **Increase production capacity in the second half of 2016**

**Maintain top market share for on-cell type touchscreen panels**

### Film-type touchscreen panels

(Making sensors on film substrate)




- **Launched in February 2015, currently in mass production**
- **Contributing to curved OLED displays**

**The first step toward achieving flexible displays**

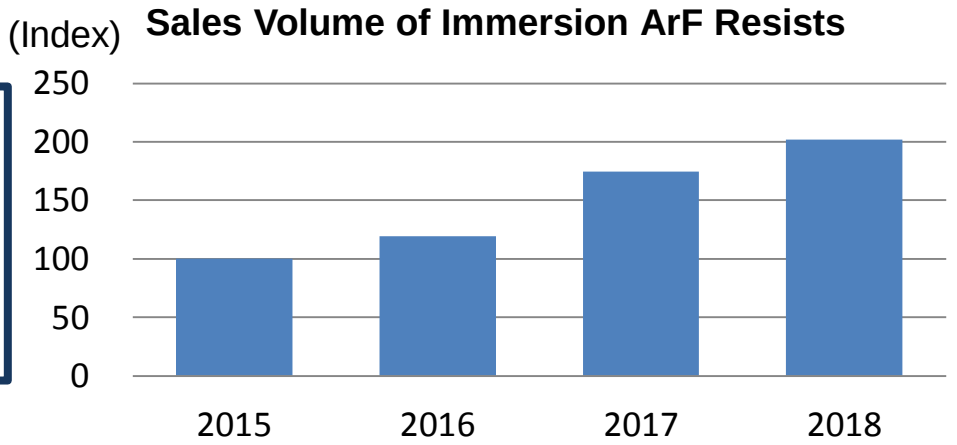
# Semiconductor Materials

*Create New Value*

## Photoresists

**Market Environment**

- High integration/miniaturization/3D
- Growth in the advanced logic and memory fields
- Evolution of packaging and assembly technology




**Immersion ArF resist market continues to expand**

**New business opportunity in post-processing**

**Basic Strategy**

- Maintain and improve high market share in immersion ArF resists
- Expand our product portfolio
- Meet the growing demand not only in Korea, Taiwan and the US, but also in China

**Development and aggressive marketing of final generation Immersion ArF resists**

**Our market share in immersion ArF resisits (Currently 32% ⇒FY2018 30%)**

**Expansion of our post-process thick i-line resist business**

**Total manufacturing from basic materials based on organic synthetic technology**

**Quality management down to the nanoscale level**

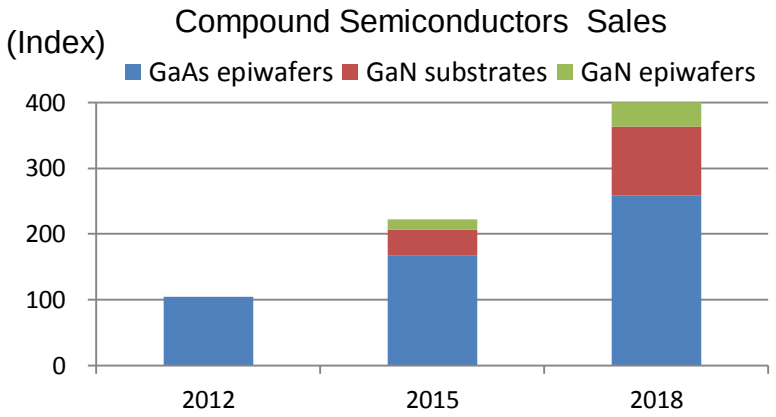
# Compound Semiconductors Materials

*Create New Value*

## Compound semiconductors

**Market Environment**

- Mobile market: Expanded information volume, increased communication speed→high output
- Power conversion devices: Miniaturization, energy saving →high endurance, low loss




**Basic Strategy**

- GaAs epiwafers
  Increase cost competitiveness
  → **Unified operations with SCIOCS Co., Ltd, Improve efficiencies through the pursuit of synergies**
- GaN substrates
  Strengthening our supply chain with the goal of becoming a leading supplier
  → **Laser diode applications: Maintaining high market share**
  **LED applications: Early stable production of 4 inch products**
- GaN epiwafers
  (GaN-on-Si, GaN-on-SiC, GaN-on-GaN)
  Establish a leading position in markets where growth is expected
  → **GaN-on-Si: Early commercialization**
  **GaN-on-SiC: Global customer development**
  **GaN-on-GaN: Development with a medium-to-long term perspective**

**Accumulated epiwafer growth technology in our GaAs business**

**Expanded product lineup from our purchase of SCIOCS Co., Ltd.**

# Contents

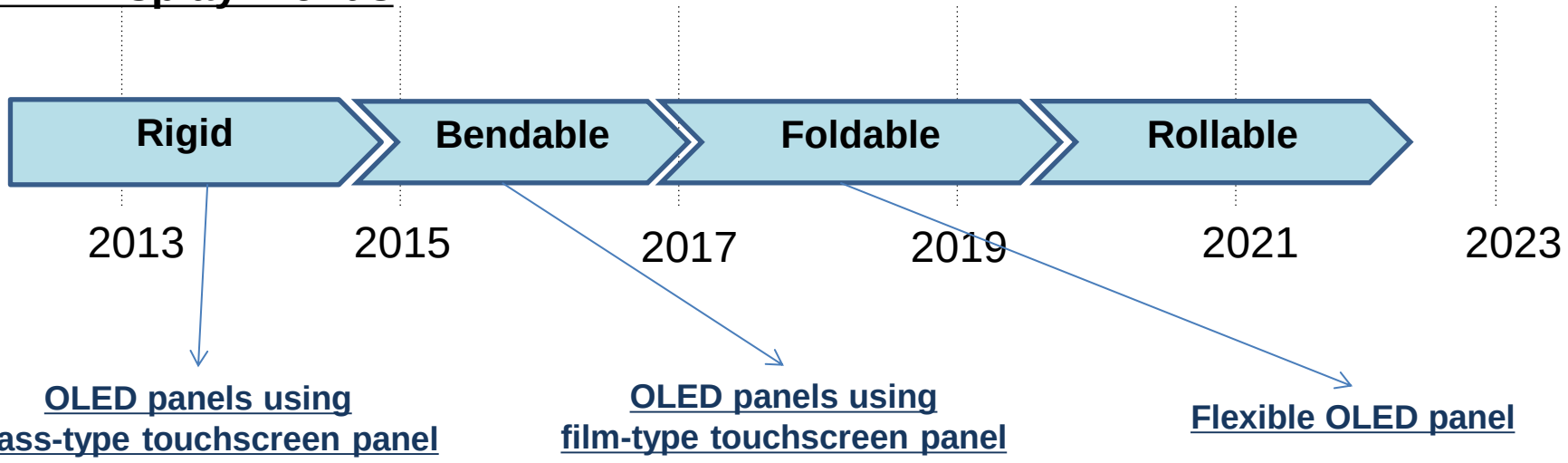
*Create New Value*

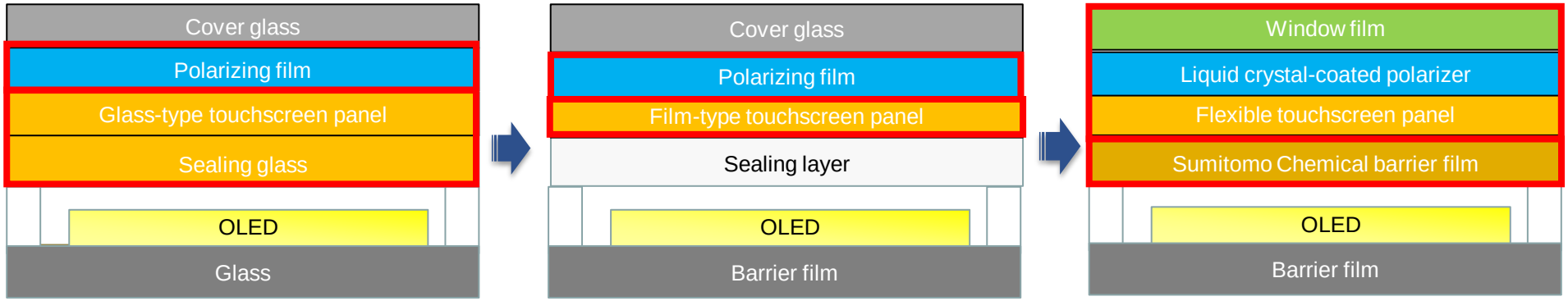
# Development of Flexible Display Materials

*Create New Value*

## Roadmap for the development of flexible display materials

### OLED Display Trends



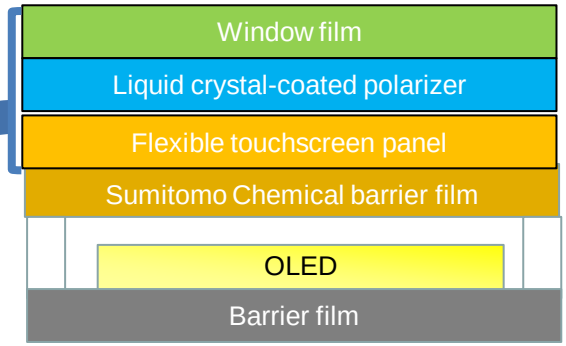




Sumitomo Chemical products

# Development of Flexible Display Materials

*Create New Value*

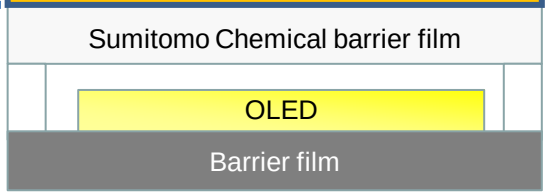
## Roadmap for the development of flexible display materials




Development and mass production of each component according to the timing of customer mass production

**Development by fiscal 2017**

**Multi-functional materials and components**




Continue parallel development of multi-functional materials and components, offer performance improvements for integration

## Sumitomo Chemical's Competitive Advantages

Materials development capability as a diversified chemical company

+

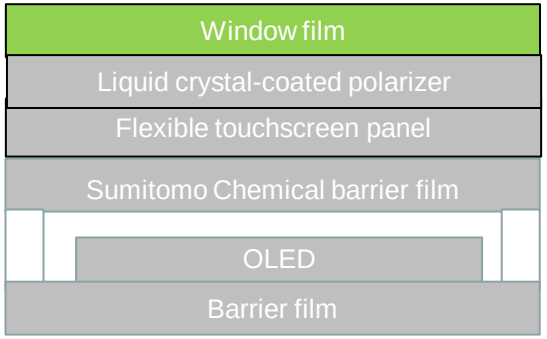
Product development capability and processing technology acquired through display materials business

**Contribute to evolution and diffusion of OLED technology**

# Development of Flexible Display Materials

*Create New Value*

## Window film



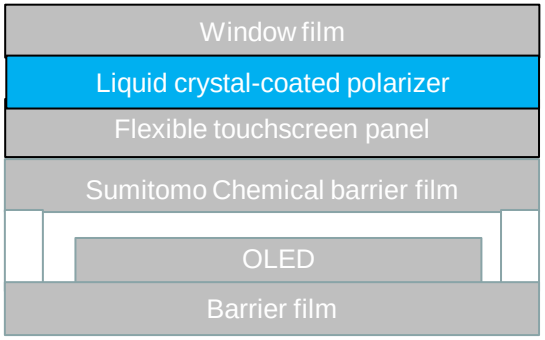

High-level balance of surface component characteristics and flexible component characteristics through polymer molecular design and process optimization

| | | | Other Companies' Products | Our Products |
|---|---|---|---|---|
| Characteristics necessary for display surface components | Transparency | Transmittance | ≤90% | **>90%** |
| | Color tone | YI | 0-5 | **1-2** |
| | Hardness | Pencil hardness | 9H | 9H |
| | Surface accuracy | Apparent reflectivity | Good | Good |
| Characteristics necessary for flexible components | Bendability | Bending test (3R) | >200,000 times | >200,000 times |
| | Low characteristic change | Water absorption | 2-3% | **<1%** |

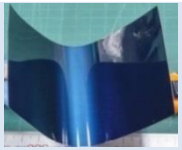
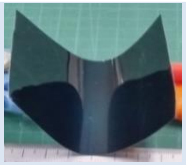
# Development of Flexible Display Materials

Create New Value

## Liquid crystal-coated polarizer



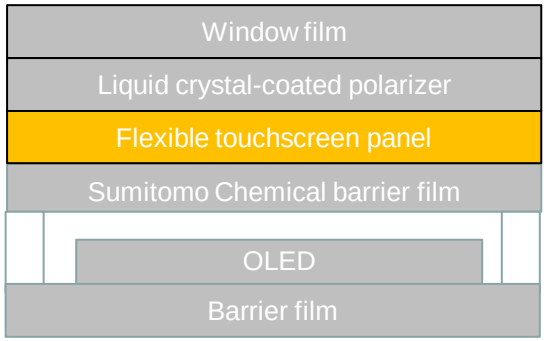

Adding characteristics of low thickness, flexible components while maintaining the fundamental characteristics of anti-reflective materials

| | | | Previous types | Liquid crystal-coated type |
|---|---|---|---|---|
| Characteristics necessary for anti-reflective components | Color tone | | Neutral | Neutral |
| | Brightness | Transmittance | 42-44% | **40-48%** |
| | Anti-reflective performance | Reflection from cells | ~0 | ~0 |
| Characteristics necessary for flexible components | Bendability | Bending test (3R) | — | **>200,000 times** |
| | | Light leakage |  *Some light leakage* |  |
| | Thickness | | >20μm | **<10μm** |
| | Dimentional stability | 95C 24Hr | Significant shrinkage | **Reduced shrinkage** |

# Development of Flexible Display Materials

*Create New Value*

## Flexible touchscreen panels



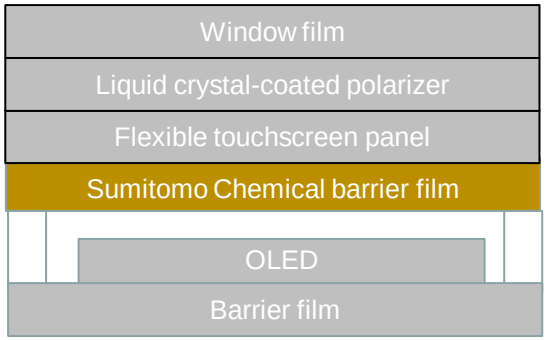

Providing the characteristics of thin, flexible components on a variety of substrates while maintaining the characteristics of an excellent touchscreen panel

| | | | Film-type (Existing products) | Flexible |
|---|---|---|---|---|
| Touchscreen panel characteristics | Line resolution | L/S (μm) | 10/10 | 10/10 |
| | Pattern visibility | | Difficult to see | Difficult to see |
| | Color tone | | Neutral | Neutral |
| Characteristics necessary for flexible components | Thickness | | 40μm-50μm | **<30μm** |
| | Bendability | Curvature radius | 3R | 3R |
| | | Bending test (3R) | — | **>200,000 times** |
| | Substrate selection | | Narrower | **Broader** |

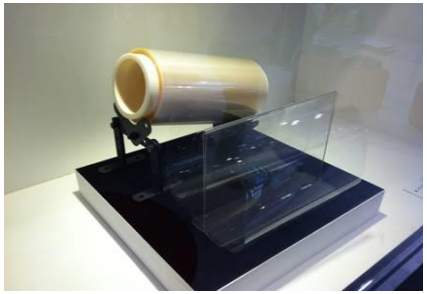
# Development of Flexible Display Materials

Create New Value

## Barrier film




Achieving both high water vapor resistance and flexibility.
Broader substrate selection, which can be applied to a variety of uses.



| | | | Other Companies' Products | Our Products |
|---|---|---|---|---|
| Barrier characteristics | Water vapor resistance | WVTR(g/m$^2$/day) | $10^{-5}$ | **$10^{-3}$-$10^{-5}$ (selectable)** |
| Characteristics necessary for flexible components | Bendability | Curvature radius | ≥20R | **≤10R** |
| | Optical characteristics | Transmittance | 88-89% | **90-91%** |
| | Substrate selection | | Narrower | **Broader** |

**Creative Hybrid Chemistry**

SUMITOMO CHEMICAL

Thank you very much.

## Cautionary Statement

Statements made in this document with respect to Sumitomo Chemical's current plans, estimates, strategies and beliefs that are not historical facts are forward-looking statements about the future performance of Sumitomo Chemical. These statements are based on management's assumptions and beliefs in light of the information currently available to it, and involve risks and uncertainties.

The important factors that could cause actual results to differ materially from those discussed in the forward-looking statements include, but are not limited to, general economic conditions in Sumitomo Chemical's markets; demand for, and competitive pricing pressure on, Sumitomo Chemical's products in the marketplace; Sumitomo Chemical's ability to continue to win acceptance for its products in these highly competitive markets; and movements of currency exchange rates.