工業技術研究院
Industrial Technology
Research Institute

# ITRI DISPLAY PROGRAM

## DISPLAY TECHNOLOGY CENTER

# *Flex Your Life*

**VISION**

*To become the pioneer of*
*Taiwan's display industry*

**MISSION**

*To lead Taiwan into the flexible display new era,*
*while continuing to invigorate the growth of the industry.*

# FOREWORD

ITRI has been developing the flat panel display technology since 1987, first in then ERSO (Electronic Research & Service Organization), later joined by Materials Research Laboratories, Union Chemical Laboratories, and Mechanical System Laboratories. The display industry in Taiwan has since grown rapidly, year after year, both in manufacturing capacity, and product variety. Today, as the manufacturers in Taiwan celebrate their global achievement, plenty of new challenges lie ahead as one searches for means to sustain the growth rate, and build the future on new generations of product and technology that meet the increasing mobile life style.


Display Technology Center (DTC), along with four other Technology Focus Centers, was established in ITRI, on January 1, 2006, as a part of the most significant restructuring effort of ITRI in its 33 years history. The objective is to align and integrate the display related projects and resources across the organizations in ITRI. As a result, DTC is positioned to play the 'center' role in ITRI to lead in tackling new wave of challenges facing the Taiwan display industry in the next decade. In this brochure, we wish to present to you some highlight of the projects and technologies that the members in DTC have proudly made contribution. We are also confident that the theme of flexible display which we choose for the future will in time bear the fruit to feed the continuous growth of the display industry.

Janglin Chen

Janglin (John) Chen, Ph.D.
Vice President and DTC General Director

# RESEARCH PROGRAM

## *Hybrid Liquid Crystal Display (LCD) Technique*

This technology is based on the single-glass substrate idea which combines the design and development of plastic color filter process. Such product can reduce its weight and thickness at least 30% compared to the conventional two-glass substrates LCD.

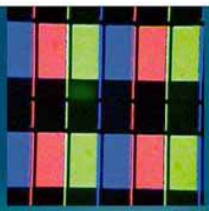
- *Set up the technology of plastic substrate process of color filter. (3.5"/4.1"/7.0")*
- *Developing low temperature sealing process and high accuracy alignment assembly technology.*
- *Developing 4.1"single-glass substrate transflective liquid crystal display technology.*

**Flexible Display Technology**

- ***Low Temperature Flexible TFT Technology***
- ***Flexible Display Media Technology***
- ***Flexible LCD Technology***

*Mask-Free Technology*
*Color Break-up Analyzing and Processing*
*Integrated Optical Film*

- ***Materials for Flexible Display***
- ***Equipment for Flexible Display***



*The pixel image of hybrid LCD*

**CNT FED**

Cabon Nano-Tube
Field Emission Display

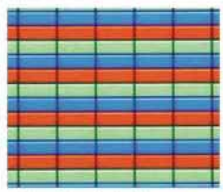
## *Flexible Bi-stable Display Technology*

This technology combines flexible substrate process, bi-stable display medium and single-layer color structure. Accomplish the development of colorful bi-stable display technology.

- *Set up technologies of controlling shrinkage of plastic substrate, low temperature sealant material process, high accuracy alignment assembly and uniform LC filling process for large size panel.*
- *Set up the single layer color bi-stable medium digital jetting process and separating area filling skill.*
- *Set up electro-optical performance measurement platform of flexible display.*

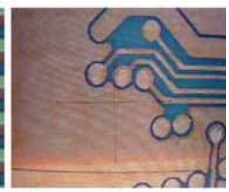
*Single-layer color bi-stable panel*

*10.4"Flexible monochrome bi-stable panel*



*Ink-jet printing of color filter array*

*Ink-jet printing of segmentation PI*



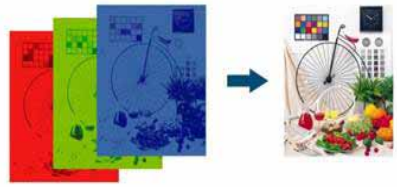
*Ink-jet printing of circuit*

## *Ink-Jet Printing Process & Mask-Free Technology*

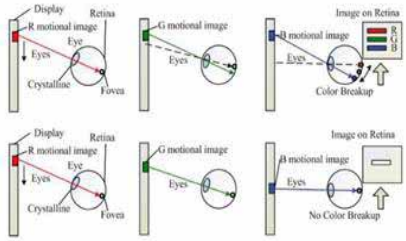
To develop mask-free technology for next generation TFT LCD, it's necessary to build up the digital ink-jet printing technology for fabricating the color filter, circuit patterning, polyimide layer, liquid crystal dispensing, polymer light-emitting diode, organic thin film transistor, organic / inorganic back light unit on display field. It not only reduces the cost but also upgrades the efficiency.

- *Print Head Driving & Quality Analysis; Printing Algorithm Design / Protocol Design / Image Trimming, Surface Treatment & Device Design.*
- *Ink-Jet Printing System Design & Integration.*
- *To develop and verify fast liquid crystal (LC) material.*
- *To develop mask free electrode with high transparency and low resistance.*

## Color Break-up Analyzing and Processing Technology



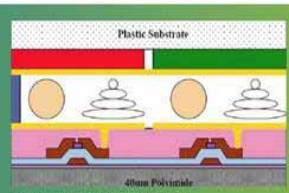
The purpose of the program is to set up a color break-up evaluating system and procedure, and to develop advanced image processing for eliminating the color break-up issues and enhancing LCD picture quality.



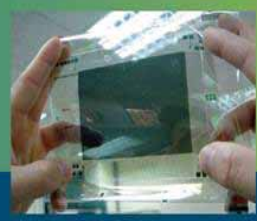

- *To build up color break-up picture evaluating procedure.*
- *To develop no-pattern design and process technology compatible with RGB LED BLU(back light unit). Furthermore, to develop multi-frequency domain driving method for enhancing LCD display quality.*

## Low Temperature Flexible Amorphous Silicon Thin Film Transistor Technology

This technology for flexible amorphous silicon thin-film transistor (a-Si TFT) array combines evaluation of transparent flexible substrate and a-Si TFT processing technology. Through the stress modeling and the analytical techniques for thin-film materials, the process of a-Si TFT array with low stress can be achieved.




*Structure of flexible a-Si TFT LCD*

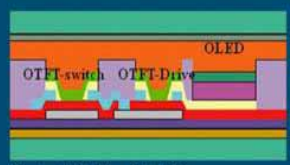


*Flexible a-Si TFT backplane*

- *To develop high accuracy photolithography process for flexible substrates.*
- *To develop reliable low temperature a-Si TFT process compatible with commercial production facilities.*
- *To establish effective metrological techniques for flexible a-Si TFT device.*

## Active Matrix Flexible Display by Organic Thin Film Transistor

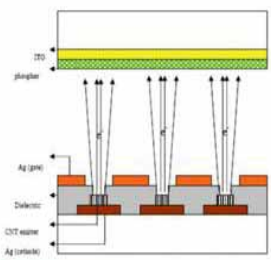
This technology for Organic Thin Film Transistor (OTFT) display combines Flexible OTFT process and flexible display.



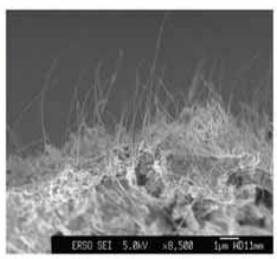

*Structure of flexible a-Si TFT LCD*

*Flexible a-Si TFT backplane*

- *To develop high accuracy photolithography process on flexible substrates.*
- *To build up the organic semiconductor deposition technology.*
- *To build up the integration technology of OTFT and OLED.*
- *To establish effective metrological techniques for OTFT device.*



*Structure of CNT FED*



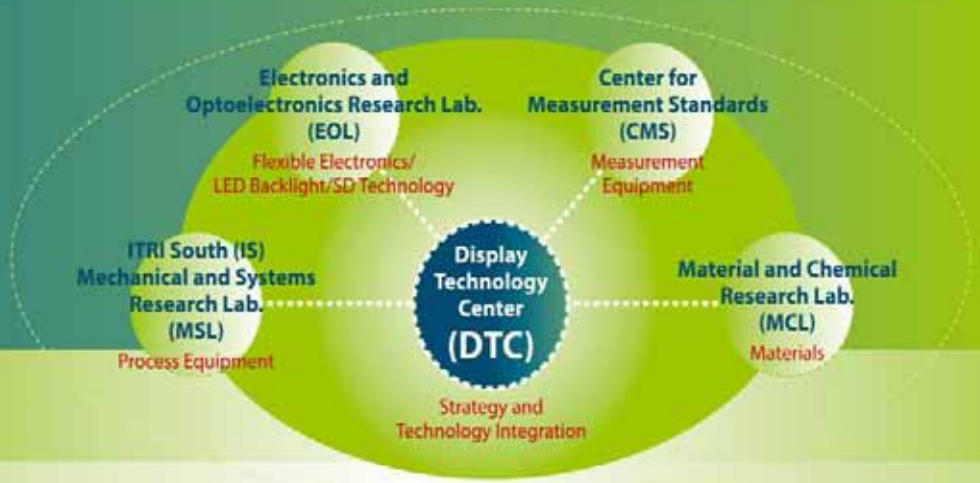

*SEM photograph of CNT Emitter*

## Carbon Nanotube Field Emission Display Technology (CNT FED)

The purpose of the program is to develop and integrate cost-competitive thick film printing process for carbon nanotube field emission display module. By realizing the unique display quality, CNT-FED technology is potential for entering the market of large-size flat panel displays.

- *To suppress driving voltage to 50 V, realizing driving circuit for a 20 inch CNT FED display.*
- *To set up process Integration of high vacuum CNT FED module, including assembly, spacer/side frame and high vacuum sealing.*

# DISPLAY PROGRAM IN ITRI




# DISPLAY PATENT PROFILE


# INTERNATIONAL PARTNERSHIP

## North America

**USA**

**Joint Development**
- EWD
- SLS Crystalization
- OLED Technology
- Cholesteric LC
- CNT-FED Materials
- Thin Film Process and Equipment
- Ink-Jet Printing

**Verification Service Contract**
- Display Process
- Single Si-TFT
- Test Cell
- P-type TFT Process

## Europe

**France, Germany**

**Joint Development**
- OLED Technology

**Russia**

**Joint Development**
- Fast LC
- CNT-FED Materials

## Asia

**Japan**

**Joint Development**
- Optical Film

# FACILITY

The clean room equipped 3124-square-foot laboratory produces 20 inch TFT-LCDs, 20 inch CNT-FEDs, 5 inch Organic-TFTs.

**Lab. and Clean Room: G2 (370x470 mm², 20"panel)**
**TFT-LCD Pilot line with 3,124 m².**

**O-TFT (5" Capacity)**

Evaporator

$O_2$ Plasma Cleaner

Ink Jet Printer

**CNT-FED (20" Capacity)**

Photo Aligner

Screen Printer

Laminator

**TFT Array** | **Cell** | **LCM**

Laser | PE-CVD | Implanter | PI Roller | Rubbing | COG | COF

# TECHNICAL SERVICES OF ITRI DISPLAY PROGRAM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