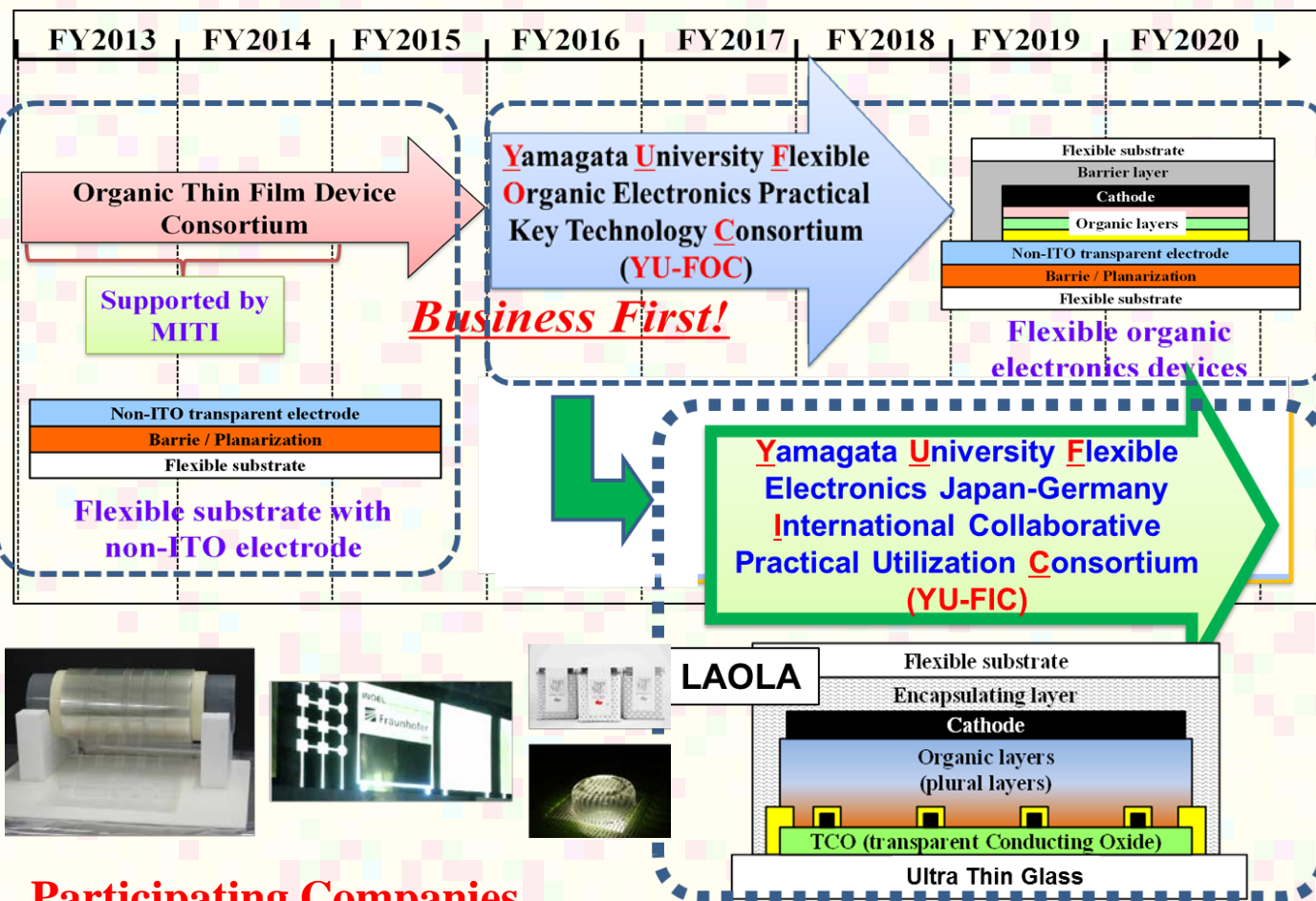


Yamagata University Flexible Electronics Japan-Germany International Collaborative Practical Utilization Consortium (YU-FIC)

Project term Oct. 2017 ~ March 2021

R&D subject

1. LAOLA: Large Area Organic Lighting Applications on ultra-thin substrates
2. IonT: Internet on Things - Intelligent OLED-OPV based Signage for interactive Advertisement
3. F2E: Free Form Electronics - Freedom in design by thermo-formed printed electronics



Participating Companies

- ♥ FUJIKURA KASEI CO., LTD.
- ♥ KEIHIN RAMTECH CO., LTD.
- ♥ Koito Manufacturing Co., Ltd.
- ♥ Mitsuboshi Diamond Industrial Co., Ltd.
- ♥ Nippon Electric Glass Co., Ltd.
- ♥ NIPPON STEEL & SUMIKIN MATERIALS CO., LTD
- ♥ Seieido Printing Co., Ltd.
- ♥ SERIA ENGINEERING, INC. (KOMORI Group)
- ♥ SurFtech Transnational Co., Ltd.
- ♥ TAKEDA PRINTING CO., LTD.
- ♥ Tokyo Process Service Co., Ltd.
- ♥ The Japan Steel Works, LTD.
- ♥ WIREDGATE Inc.

Equipment / Members

Equipment

Four original roll-to-roll (R2R) equipment (Roll width: 30cm)



R2R sputtering
&CVD
(KOBELCO)



R2R screen printing
(SERIA)



R2R Gravure offset and Flexography
printing (Komori Machinery/ Taiyo
Kikai)



R2R wet cleaning
(FEBACS)

Device fabrication equipment



Organic
deposition
(G1 substrate)



Organic
deposition



Sputtering



Laminator



Gravure offset and
Flexography printing



Screen printing



Ink-jet

Sheet-to-sheet (S2S) printing equipment

Analysis and evaluation equipment



Ca method



WVTR



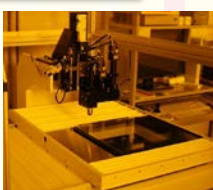
Bending



Viscoelasticity
measurement



Hybrid
confocal
microscopy



Precise position
detector

Members

YU-FIC Fellow



Professor
Dr. Tatsuhiro Takahashi

effort@yz.yamagata-u.ac.jp
(Field)

Polymer chemistry, composite material,
Administration, International collaboration
(Biography)

1988 Graduated at Waseda University
(Master degree)
1988~1998 DuPont
1996 Graduated at Yamagata University
(PhD)
2002~ Yamagata University
2008~ Yamagata University, Professor
2016~ Yamagata University, Director of
INOEL

YU-FIC Chair



Associate Professor
Tadahiro Furukawa

ta-furukawa@yz.yamagata-u.ac.jp
(Field)

Fine patterning technology,
Printing, Roll-to-roll technology
(Biography)

1984 Graduated at Saitama
University (Master degree)
1984~2011 Kyoto Printing Co., Ltd.
R&D and production of Color
filter (CF), flexible CF and
LCD
2011~ INOEL, Yamagata University
(current position)

YU-FLEC Secretary



Professor
Dr. Mitsuhiro Kodon

koden@yz.yamagata-u.ac.jp
(Field)

Field: LCD, Display, OLED, Chemistry
(Biography)

1983 Graduated at Osaka University
(PhD)
1983~2012 Sharp Corporation (Liquid crystal
materials, LCD, OLED display, etc.)
1998~2011 Guest prof. of Nara Institute of
Science and Technology
2012~ INOEL, Yamagata University
(current position)

Ultra Thin Glass / Barrier Film / Printing / R2R

Flexible OLED panel with ultra-thin glass

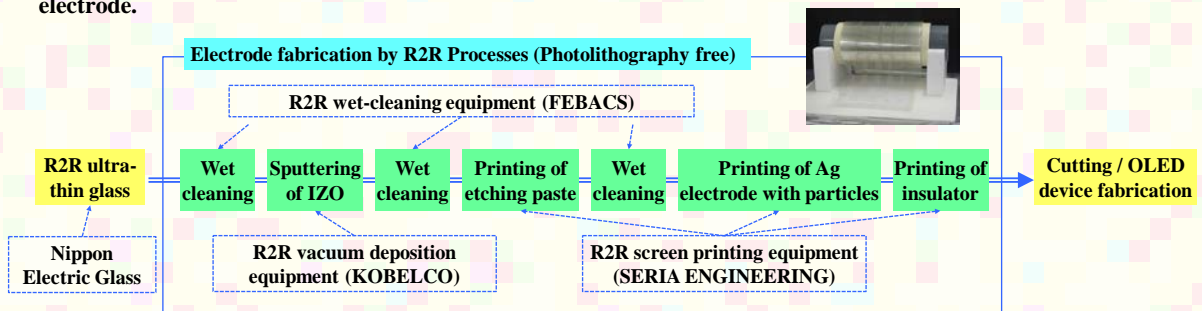
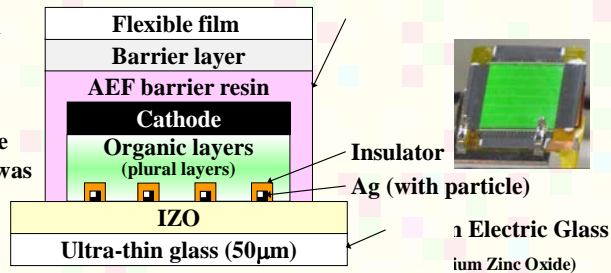
(Collaborating with Nippon Electric Glass and SERIA ENGINEERING)

T. Furukawa, N. Kawamura, T. Noda, Y. Hasegawa, D. Kobayashi, M. Kodon, IDW'17, FLX6-2 (2017).

Flexible OLED panels were developed on ultra-thin glass (thickness: 50 μ m) with transparent electrode fabricated by roll-to-roll (R2R) processes.

The following results were also obtained.

- 1) ITO tends to reduce mechanical strength due to the mechanical stress. As a counter technology, IZO was applied.
- 2) The inclusion of reflective particles to Ag assisting electrode reduces the attention of the assisting electrode.

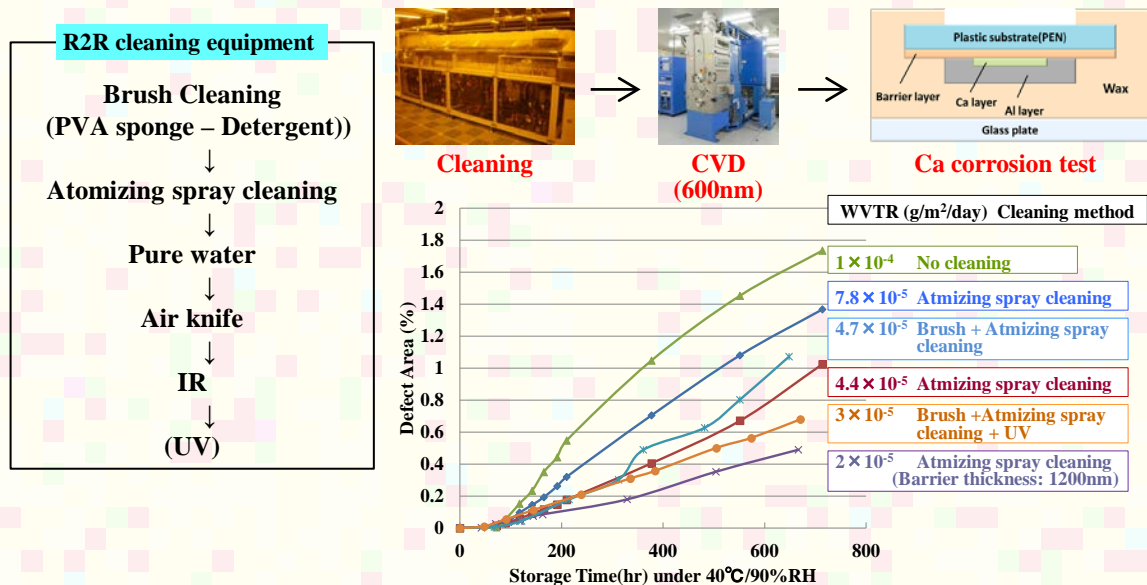


The effect of wet cleaning on barrier property of flexible film

(Collaborating with FEBACS and Teijin)

T. Furukawa, N. Kawamura, M. Kodon, H. Itoh, H. Kuroiwa, K. Nagai, LOPEC (2017).

The effect of wet cleaning on barrier property of flexible film was investigated by using roll-to-roll (R2R) wet cleaning equipment, finding that wet cleaning improves barrier property.



Topics / Publication

Award

- H. Nakada, M. Koden, "Award from Minister of State for Science and Technology Policy", Cabinet Office, Government of Japan, (2017).

Book

- M. Koden, "OLED Displays and Lighting" (Wiley, IEEE Press) (2017).

Paper

- T. Furukawa, M. Koden, IEICE Trans. Electron, E100-C, 949-954 (2017).
"Novel roll-to-roll deposition and patterning of ITO on ultra-thin glass for flexible OLEDs"

International Conference

- T. Furukawa, N. Kawamura, T. Noda, Y. Hasegawa, D. Kobayashi, M. Koden, IDW'17, FLX6-2 (2017).
"Novel Roll-to-Roll Fabrication Processes of Transparent Electrodes on Ultra-Thin Glass"
- K. Taira, T. Furukawa, N. Kawamura, M. Koden, T. Takahashi, IDW'17, FLXp1-8L (2017).
"High gas barrier film for OLED"
- T. Furukawa, N. Kawamura, M. Koden, H. Itoh, H. Kuroiwa, K. Nagai, LOPEC (Large-area, Organic & Printed Electronics Convention) (2017). "Gas barrier film for OLED devices"
- M. Koden, T. Furukawa, T. Yuki, H. Kobayashi, H. Nakada, IDW/AD'16, FLX3-1 (2016). [Invited]
"Substrates and Non-ITO Electrodes for Flexible OLEDs"
- T. Furukawa, M. Sakakibara, N. Kawamura, M. Koden, IDW/AD'16, FLX3-3 (2016).
"All-printed non-ITO Transparent Electrodes on Ultra-thin Glass for OLED Lighting"
- T. Furukawa, International Workshop on Flexible & Printable Electronics (IWFPE2016) (2016). [Invited]
"Flexible Substrates and Printed Transparent Electrode for OLED Lighting"
- T. Furukawa, N. Kawamura, H. Nakada, M. Koden, The International Conference on Flexible and Printed Electronics (ICFPE 2016), O15-6 (2016). "Novel ITO fabrication processes on ultra-thin glass"
- M. Koden, 15th International Symposium on the Science and Technology of Lighting (LS15) (2016). [Invited]
"Substrates and non-ITO electrodes for flexible OLED Lightings"
- T. Furukawa, 2016 International Conference on Electronics Packaging (ICEP2016) (2016). [Invited]
"Printing Technology for Electronics"
- M. Koden, The 10th Taiwan Solid State Lighting (2016 tSSL) Symposium, B-4 (2016). [Invited]
"Flexible OLED Lighting"

Exhibition

- "Printable electronics 2017" (Feb. 2017).
- "G7 Exhibition" (May. 2016).
- "Printable electronics 2016" (Jan. 2016).
- "International Photonics Exhibition 2015" (Korea) (Oct. 2015).
- "National Museum of Nature and Science (Japan)" (May 2015).
- "Printable electronics 2015" (Jan. 2015).



"Printable electronics 2017"
(Feb. 2017)



"Printable electronics 2016"
(Jan. 2016)



"International Photonics Exhibition 2015"
(Korea) (Oct. 2015)

PEPIO F6 Gravure Offset Printer

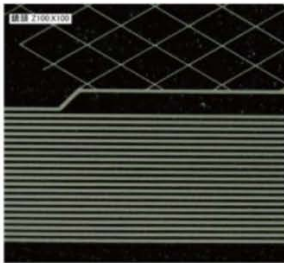
Super fine line beyond screen printing



Specifications

Substrate	Material	Plastic Film, Glass
	Size	Max.160×160mm
	Thickness	0.05 ~ 2.0mm
Printing area		Max.150×150mm

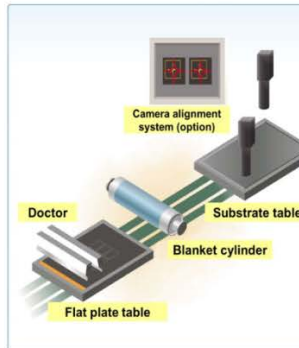
Fine line printing



Fine line PRINTING

- L/S=30/30μm
- Metal mesh width: 5μm

Mechanism



RYURONE 30SZ Gapless Roll-to-roll Screen Printer

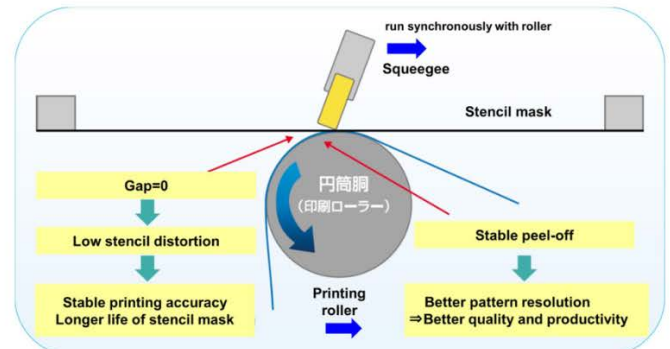
"Gap=0" makes new screen printing world



Specifications

Substrate	Material	Plastic Film Green sheet Ultra thin glass
	Maximum width	300mm
	Thickness	25 ~ 100μm
Printing area		Max.280×280mm

Mechanism



KOMORI Group
SERIA
SERIA CORPORATION

Contact information:
Eiji Iida
Overseas sales dept. (Tokyo Japan)
E-mail: iida@seria.co.jp
Phone: +81-3-3800-1050



TOKYO PROCESS SERVICE CO., LTD.



Tokyo Process Service manufactures and sells various masks and their related products. Screen masks and photomasks are our main products. Our major customers include 400 electronic component manufacturers worldwide.

Introduction of an example of a new product

	Screen Mask Next Generation	Usual
Picture	 Line width 10μm MESH:Macro-sieve 640 mesh Thickness 8μm Image:Chip inductor image Metal film thickness 10μm Line width 30μm	 Line width 10μm (could not open) *exceeding the resolution limit MESH:SUS304 640 mesh Thickness 21μm Image:Line resolution test pattern Emulsion thickness 10μm Line width 30μm
Main Material	Non-woven electroforming mesh (nickel) Electroforming stencil (nickel)	Woven mesh(sus304 ,sus316,polyester etc.) Emulsion(vinyl acetate, polyvinyl alcohol, acrylic resin etc.)
Characteristics	No swelling with solvent Less uneven High density mesh pitch(60/inch~1500/inch)	Mesh pitch max: 900/inch

Business Areas



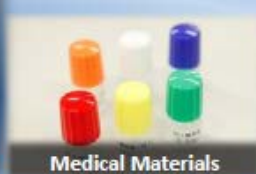
Coatings for Plastics



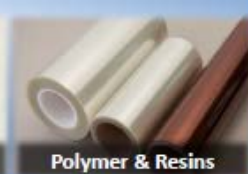
Architectural Coatings



Electronics Materials



Medical Materials



Polymer & Resins

Company Profile

- Establishment : Sep. 22 1938
- Capital : 5,352 million JPY
- Employees : 394
- Sales(in Y2016) :
 - (Non-consolidated) : 18,625 million JPY
 - (Consolidated) : 73,741 million JPY



DOTITE Electrically Conductive Paste

In 1957, the first manufacturer in Japan to develop and sell electrically conductive pastes.



Key Technology



Formable



Stretchable



EMI Shielding



Low Resistivity



Flexible



Fine Line Printable

Contact Window

s-tajitu@fkkasei.co.jp
d-dewey@fkkasei.co.jp
<http://www.fkkasei.co.jp/>

“TAKEDA PRINTING” overview

Name	TAKEDA PRINTING Co.,Ltd. (URL : http://www.takeda-prn.co.jp)
Head office	1-11-10 Shirakane, Showa-ku, Nagoya JAPAN
Establishment	16 Nov. 1946
Business contents	1. Printing business 2. Electronics business 3. Expand printing business
Capital	JPY 1,937,920,000 (as of Mar. 2019)
Employees	Consolidated 1,093 (as of Mar. 2019)



• Osaka office
• Ohta plant



• Tokyo office
• Koshigaya plant



• Head office & plant
• Tech center
• Logistic center



Business contents

1. Printing business

In the principal printing business, it supports not only general commercial printing but also special printing and newspaper printing.



2. Electronics business

Manufacturing photo masks, screen masks and stencil masks. We are building an integrated production system from designing to manufacturing of masks.



3. Expand printing business

Expanding from printing business, we develop internet sale business and logistics business adjusted to market needs.





RAM
KEIHIN RAMTECH CO.,LTD.

Introduction of Keihin Ramtech



We are started development of several sputtering cathodes and components since 2004.



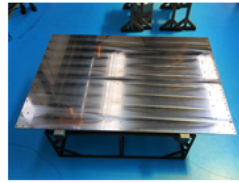
We were born in 1972

July 1972
Keihin Ramtech Co. Ltd was founded

FSW was installed in 2003

March 2003
Opened Ibaraki Office, 2 Portal MC5 Surface Processors and 1 FSW No.1 were introduced

Started development of low damage cathodes



2004

October 2004
Addition of Ibaraki Second Plant and introduction of FSW No. 2

March 2007
Introduction of 1 Portal MC

2008

July 2008
Introduction of 1 MC to Ibaraki Office

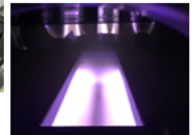
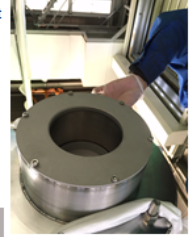
2011

May 2011
Introduction of 2 MCs to Ibaraki Office, 1 MC to Yokohama Office

2012

Quality management international standard ISO9001 certification acquisition

Low Damage Cathodes



Keihin RAM Tech Co.,Ltd.
Mail address : h-iwata@ramtech.jp

Telephone : +81-45-473-2481
JAPAN

Revolutionary Adventuring Manufactures

www.ramtech.jp

新日鉄住金マテリアルズ株式会社
NSMAT

Innovate the World
with Advanced Materials

Stainless Steel Foil for Flexible Electronics

NIPPON STEEL & SUMIKIN MATERIALS has developed planarized and electrical insulated stainless steel foil for flexible electronics devices.

TYPICAL SPECIFICATIONS

- Manufacturing Process: Roll to Roll
- Stainless Steel Foil Thickness :20~50μm
- Coating Film Thickness :2~10μm
- Width: Max. 400mm

FEATURES

- Low Surface Roughness (Ra<1nm)
- Electrical Insulation
- High Flexibility (r>2.5mmφ)

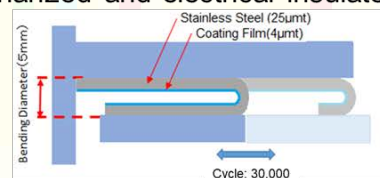
CONTACT

NIPPON STEEL & SUMIKIN MATERIALS CO., LTD.
Jun Nakatsuka
16-3,GINZA 7-CHOME,CHUOKU,TOKYO 104-0061 JAPAN
E-mail nakatsuka.7zs.jun@nsmat.nssmc.com
URL <https://nsmat.nssmc.com/english/>

Coating Film



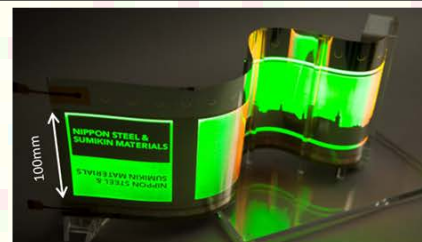
Schematic of cross section



Method of flexibility test※

Results of flexibility test

Properties	Flexibility test		
	Before	After	Comment
Roughness Ra nm	0.6	0.6	No Change
Leakage current A/cm ² at 100V	≤ 1 ⁻¹⁰	≤ 1 ⁻¹⁰	No Change
Observation of surface by SEM	No Crack	No Crack	No Change



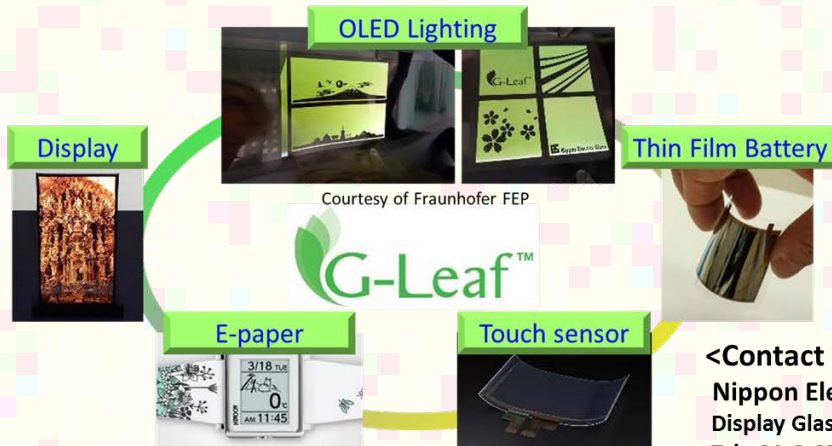
OLED lighting fabricated by Fraunhofer FEP

※ U-shape sliding plate test was carried out as a part of the activity of "Yamagata University Flexible Organic Electronics Practical Key Technology Consortium (YU-FOC)".



- G**lass/**G**reen
- L** **L**ight weight
- e** **e**cological/**e**ndurable
- a** **a**dvanced
- f** **f**lexible

Rolled-up form is available



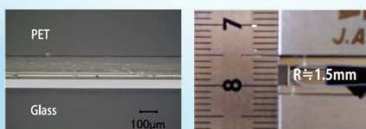
<Contact Information>
Nippon Electric Glass Co.,Ltd
Display Glass Division, Sales
Tel:+81-6-6399-2711

Copyright ©2018 Nippon Electric Glass Co., Ltd.

Ultimate high quality cutting for ultra thin glass

Successful solution for implementing ultra thin glass.
Cutting-edge mechanical glass scribe/break process for minimum radius and less chipping.

Examples of processing



Maximal bending is possible using resin laminated glass. *Resin cutting with MDI laser processing machine.

Feature

- Clean cutting
- Narrower (Pitch vs. thickness)
- High strength
- Higher verticality

Application

Flexible lighting, flexible display, flexible touch sensor panel, flexible PV cell, semiconductor barrier glass & interposer, small glass window, and others.

Roll to sheet cutting

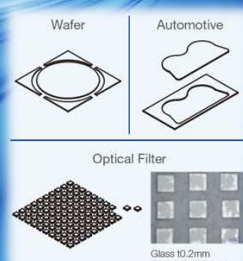
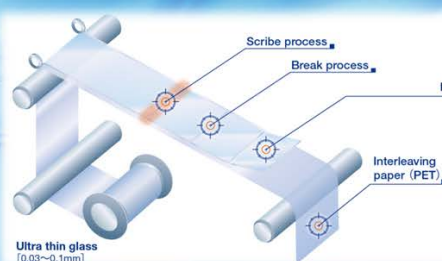


MRC

Free shape cutting



MUGP



Contacts

Mitsubishi Diamond Industrial Co., Ltd. 32-12 Koroen Settsu, Osaka 566-0034, Japan TEL +81-72-648-5211
<https://www.mitsuboshidiamond.com/en/>
MDI Advanced Processing GmbH Obere Auersasse 6, 55120 Mainz, Germany TEL:+49(0)6131-7321-0
<http://www.mdi-ap.de/>