INOEL Yamagata University Innovation Center for Organic Electronics

山形大学 Yamagata University

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

Yamagata University has constructed close connection with Saxony/Dresden in Germany in the field of organic electronics, coworking with Yamagata prefecture and Yonezawa city.
Yamagata University Flexible Electronics Japan-Germany International Collaborative Practical Utilization Consortium (YU-FIC) collaborates with companies and institutes in Germany, aiming at novel flexible electronics products.

Project term

October 2017 ～ March 2021

Subjects

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

Leaders

- Project leader: Associate Prof. T. Furukawa
- Fellow: Prof. T. Takahashi
- Secretary: Prof. M. Koden

Participants (Jan. 2019)

FUJIKURA KASEI CO., LTD.
KEIHIN RAMTECH CO., LTD.
KOMORI Corporation
Mitsuboshi Diamond Industrial Co., Ltd.
Nippon Electric Glass Co., Ltd.
NIPPON STEEL Chemical & Material CO., LTD.
Seieido Printing Co., Ltd.
SERIA ENGINEERING, INC.
SurFtech Transnational Co., Ltd.
TAKEDA PRINTING CO., LTD.
TEIJIN LIMITED
Tokyo Process Service Co., Ltd.
The Japan Steel Works, LTD.
WIREDGATE Inc.

Collaboration with German activity

YU-FIC collaborates with 24 German companies and institutes which are organized by Organic Electronics Saxony (OES), having twice visits a every year, respectively.

Activity


Germany (Nov. 2017)


Japan (Feb. 2018)

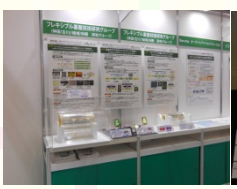

LOPEC (Mar. 2018)


Germany (Sep. 2018)


IDW'18 (Dec. 2018)







Germany-Japan Joint Workshop(Jan. 2019)　Japan (Jan. 2019)　JFlex 2019 (Jan. 2019)

Related program

- JST: Program on Open Innovation Platform with Enterprises, Research Institute and Academia (OPERA) [FY2016～FY2020]
- MEXT: Construction Program of Open Innovation Organization [FY2018～FY2022]
- MEXT: Regional Innovation Eco-system Program [FY2018～FY2022]

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Printing and Roll-to-roll (R2R) Technologies

We provide printing and roll-to-roll (R2R) technologies, aiming at an innovation of production in flexible organic electronics.

Printing / Coating

Various printing equipment can be utilized for printing tests and device fabrications.

Screen printing

Flexography and gravure offset printing

Processing

3D forming

Laminator

Roll-to-roll (R2R)

Four types of unique roll-to-roll (R2R) equipment are utilized for fabrications of electrodes, barrier layers, organic layers, etc.

- **Substrate width：30cm**
- **Substrate: ultra-thin glass, stainless steel foil, flexible film**

R2R sputtering &CVD (KOBELCO)

R2R screen printing (SERIA)

R2R gravure offset and flexography printing (KOMORI / Taiyo Kikai)

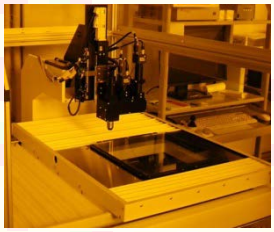
R2R wet cleaning (FEBACS)

Evaluation

Various evaluation equipment are used for R&D of printing and roll-to-roll (R2R) technologies.

Viscoelasticity measurement

Hybrid confocal microscopy



Precise position detector

Contact angle measurement

Related program

- **MITI: “R&D subsidiary program for promotion of academia-industry cooperation” [FY2013～FY2014]**
- **MEXT: Regional Innovation Strategy Support Program [FY2011～FY2015]**

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Flexible OLEDs on Ultra-Thin Glass

We develop flexible OLED devices on ultra-thin glass G-Leaf® (Nippon Electric Glass).

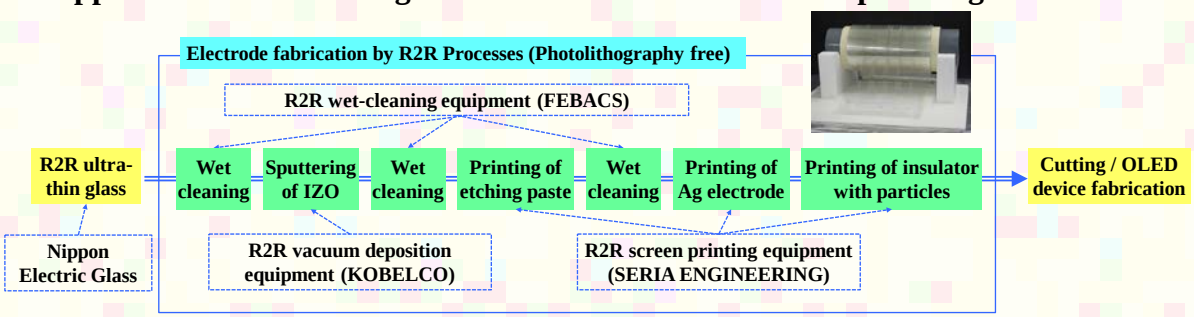
Technological features

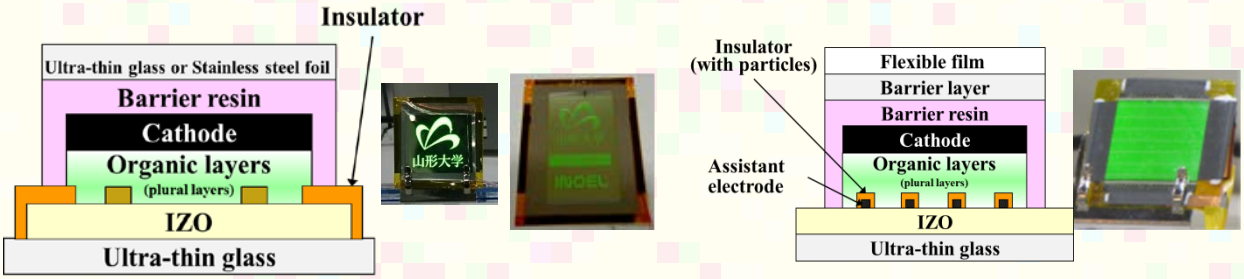
■ **Advantages of ultra-thin glass G-Leaf® of Nippon Electric Glass**
- **Flexible and roll shape due to thin thickness such as 50μm**
- **Intrinsic advantages of glass (gas barrier, surface smoothness, temperature stability, chemical stability, size stability, etc.)**

■ **Application of ultra-thin glass to flexible OLED devices.**
- **Handling technologies overcoming the brittleness of ultra-thin glass**

Developed technologies

■ **Flexible OLED devices on ultra-thin glass with the thickness of 50μm**
- **Roll-to-roll (R2R) fabrication of transparent electrodes on ultra-thin glass without photolithography**
- **Application of ultra-thin glass to OLED substrate and encapsulating substrate.**





Collaboration

Nippon Electric Glass, SERIA ENGINEERING, FEBACS, Mitsuboshi Diamond Industrial, NIPPON STEEL Chemical & Material

Related program

- **Yamagata University Flexible Organic Electronics Practical Key Technology Consortium (YU-FOC) [Apr. 2016〜Mar. 2019]**
- **Yamagata University Flexible Electronics Japan-Germany International Collaborative Practical Utilization Consortium (YU-FIC) [Oct. 2017〜Mar. 2021]**
- **MEXT: Construction Program of Open Innovation Organization [FY2018〜FY2022]**

Publication

- **Nippon Electric Glass; "LED JAPAN 2018" (Oct. 2018), "FINETECH JAPAN 2018" (Dec. 2018).**
- **Mitsuboshi Diamond Industrial; "FINETECH JAPAN 2018" (Dec. 2018).**
- **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"**
- **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"**

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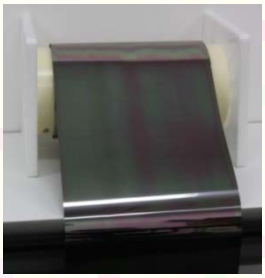
Flexible OLEDs on Stainless Steel Foil

We develop flexible OLED devices with stainless steel foil (thickness: 50μm) of NIPPON STEEL & SUMITOMO METAL CORPORATION GROUP.

Technological features

■ **Advantages of stainless steel foils of NIPPON STEEL & SUMITOMO METAL CORPORATION GROUP**

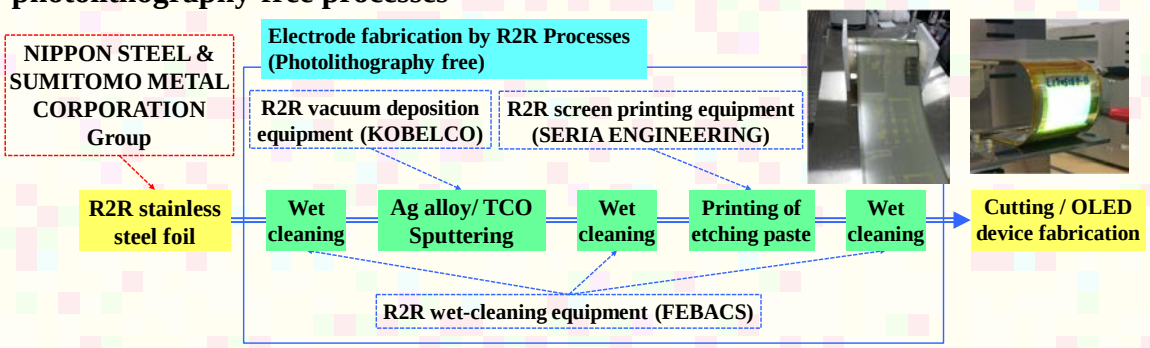
- **Thickness: 50μm**
- **Excellent surface smoothness（Ra～0.6nm）**
- **Excellent temperature and process resistances**

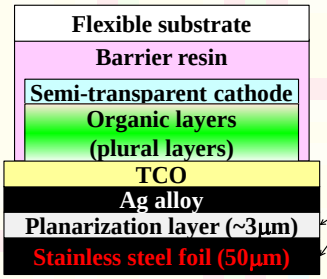


Stainless steel foil

Developed technologies

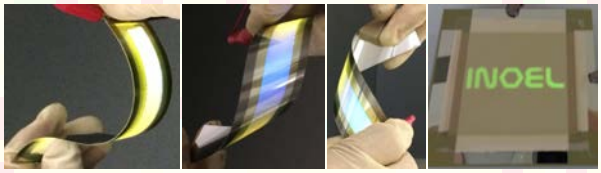
■ **Flexible OLED on stainless steel foil**
Electrode (reflective anode) is fabricated on stainless steel foil by roll-to-roll (R2R) photolithography-free processes





NIPPON STEEL & SUMITOMO METAL CORPORATION Group

(TCO: Transparent conducting oxide)



Flexible OLEDs on stainless steel foil

Collaboration NIPPON STEEL & SUMITOMO METAL CORPORATION GROUP

Related program

- **Yamagata University Flexible Electronics Japan-Germany International Collaborative Practical Utilization Consortium (YU-FIC) [Oct. 2017～Mar. 2021]**
- **Yamagata University Flexible Electronics Consortium for Academia-Industry Cooperation (YU-FLEC) [Jan. 2018～Mar. 2023]**
- **MEXT: Construction Program of Open Innovation Organization [FY2018～FY2022]**

Publication

- **Y. Hagiwara, T. Furukawa, T. Yuki, S. Yamaguchi, N. Yamada, J. Nakatsuka, M. Koden, H. Nakada, *IDW'17*, FLXp1-9L(2017). "Roll-to-Roll Patterning of Reflective Electrode on Planarized Stainless Steel Foil"**
- **M. Koden, T. Furukawa, T. Yuki, H. Kobayashi, H. Nakada, *IDW/AD'16*, FLX3-1 (2016). "Substrates and Non-ITO Electrodes for Flexible OLEDs"**
- **Y. Hagiwara, H. Itoh, T. Furukawa, H. Kobayashi, S. Yamaguchi, N. Yamada, J. Nakatsuka, M. Koden, H. Nakada, *IDW/AD'16*, FLXp1-5 (2016). "Roll-to-Roll Processing of Silver/ITO Continuous Deposition on Planarized Stainless Steel Foil"**

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Barrier Films for Flexible OLEDs

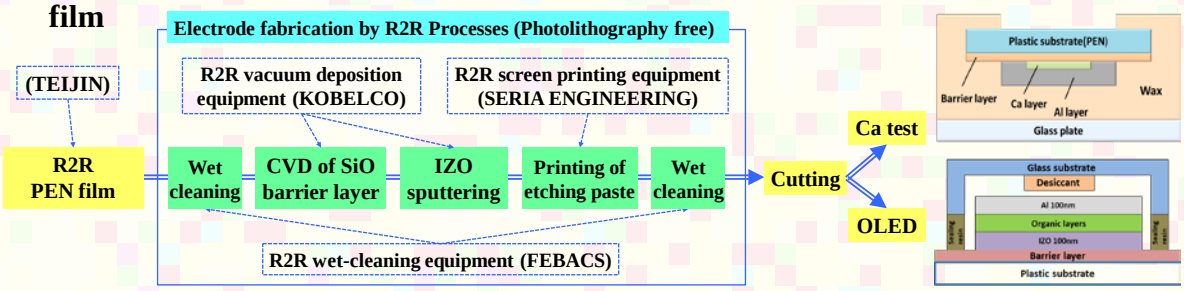
We develop fabrication technologies of gas barrier layer on PEN film (TEIJIN), using roll-to-roll (R2R) PE-CVD.

Technological features

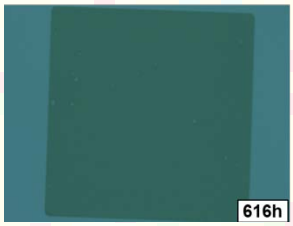
- **Roll-to-roll (R2R) PE-CVD deposition of gas barrier layer on PEN film**
- **High barrier ability with WVTR of the order of 10^{-6}g/m^2/day**
- **High gas barrier films with transparent electrode**

Developed technologies

- **Roll-to-roll (R2R) fabrication of barrier layer and transparent electrode on PEN film**

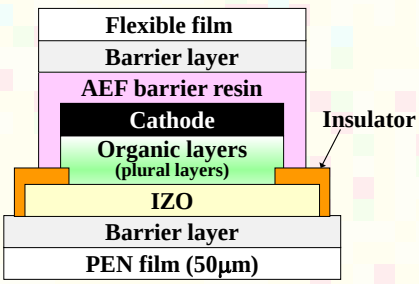


- **High gas barrier property (WVTR: 6.3×10^{-6}g/m^2/day)**



Ca corrosion device after 616 hours under 40℃/90%RH (Thickness of barrier layer: 720nm)

- **Flexible OLED devices**



Collaboration TEIJIN LIMITED, Tosoh Corporation, FEBACS CO., LTD.

Related program

- Yamagata University Flexible Organic Electronics Practical Key Technology Consortium (YU-FOC) [Apr. 2016〜Mar. 2019]
- Yamagata University Flexible Electronics Japan-Germany International Collaborative Practical Utilization Consortium (YU-FIC) [Oct. 2017〜Mar. 2021]
- JST: Program on Open Innovation Platform with Enterprises, Research Institute and Academia (OPERA) [FY2016〜FY2020]
- MEXT: Construction Program of Open Innovation Organization [FY2018〜FY2022]

Publication

- K. Taira, Taiga Suzuki, W. Konno, H Chiba, H. Itoh, M. Koden, T. Takahashi, T. Furukawa, *IDW'18*, FLX2-4L (2019). "Development of High Gas Barrier Film Using Novel Precursor by Roll to Roll PECVD"
- ・T. Suzuki, W. Konno, K. Taira, H Chiba, H. Itoh, M. Koden, T. Takahashi, T. Furukawa, *IDW'18*, FLXp1-10L (2019). "High Gas Barrier Films with Heterogeneous Multilayer"
- K. Taira, T. Furukawa, N. Kawamura, M. Koden, T. Takahashi, *IDW'17*, FLXp1-8L (2018). "High gas barrier film for OLED"

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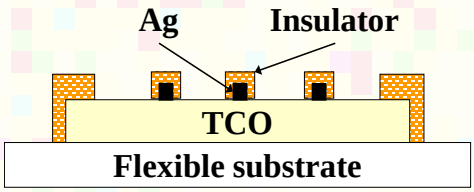
Roll-to-roll (R2R) Fabrication of Flexible Substrates with Electrode

We develop roll-to-roll (R2R) fabrication technologies of flexible substrates with electrode, aiming at large size OLED lighting.

※Collaboration with German companies and institutes in Yamagata University Flexible Electronics Japan-Germany International Collaborative Practical Utilization Consortium (YU-FIC)

Technological features

■ **Roll-to-roll (R2R) fabrication of electrodes on flexible substrates by photolithography-free processes. (low cost, high productivity)**



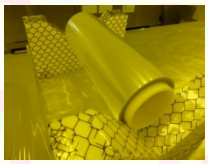
（TCO: Transparent Conducting Oxide）

R2R sputtering of TCO layer
↓
R2R screen printing of etching paste
↓
R2R wet cleaning for TCO patterning
↓
R2R screen printing of Ag electrode
↓
R2R screen printing of insulator

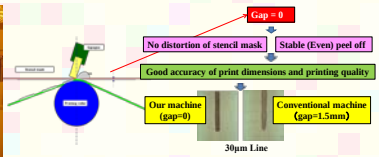
Key technologies

Ultra-thin glass
(Nippon Electric Glass)

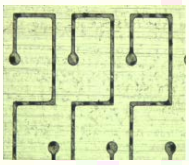
Stainless steel foil
(NIPPON STEEL Chemical & Material Co., Ltd.)



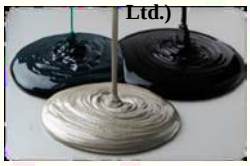
Plastic film
(TEUJIN)

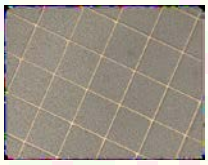


Screen printing equipment
(SERIA ENGINEERING)



Screen mask
(Tokyo Process Service)





Conducting ink
(FUJIKURA KASEI)

Cutting
(Mitsuboshi Diamond Industrial)

Flexible OLED device
(Yamagata University)
Barrier resin: tesa

Collaboration

Nippon Electric Glass, NIPPON STEEL Chemical & Material, TEIJIN, SERIA ENGINEERING, Tokyo Process Service, FUJIKURA KASEI, Mitsuboshi Diamond Industrial

Related program

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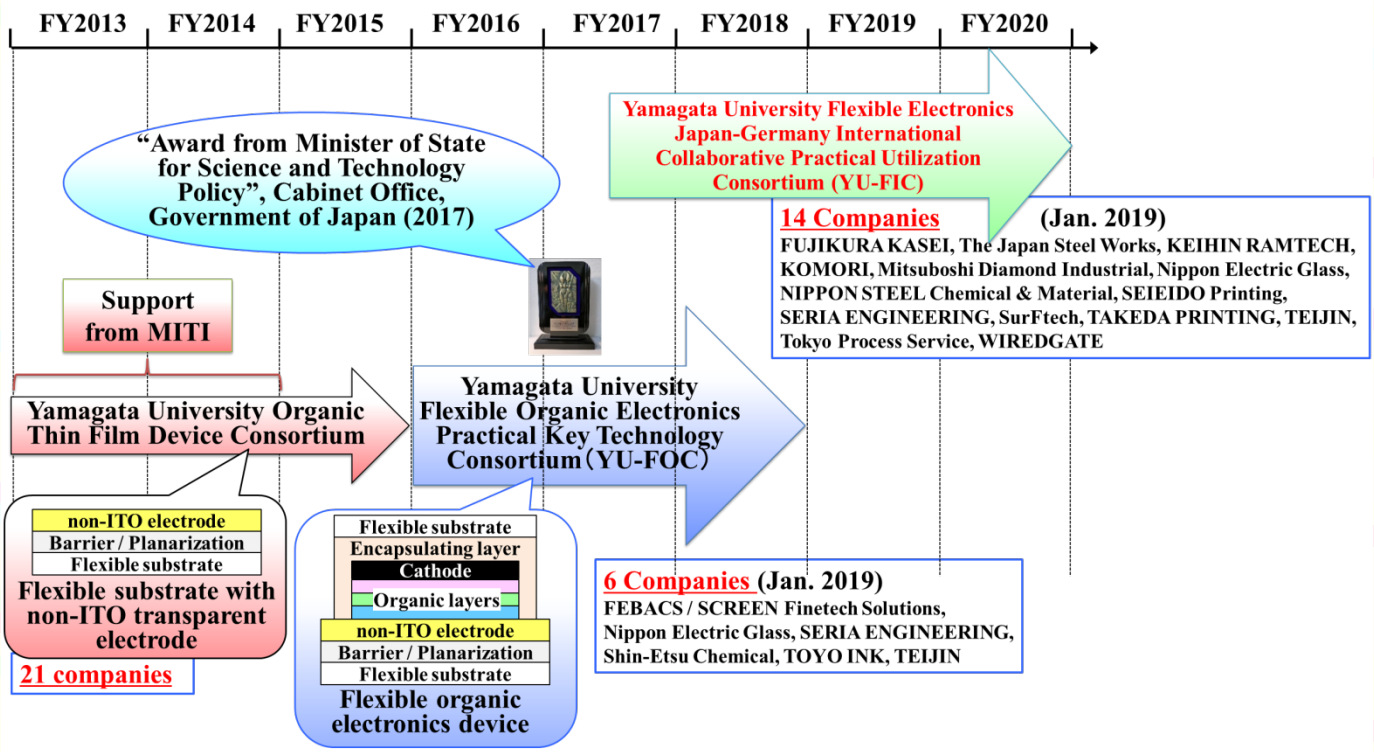
YU-FIC
Academia-Industry Collaboration Consortium



日鉄ケミカル&マテリアル株式会社

素材を極め、未来を拓く。
For Your Dream & Happiness

Stainless Steel Foil for Flexible Electronics

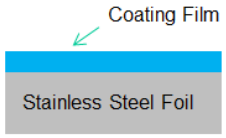
NIPPON STEEL Chemical & Material has developed planarized and electrical insulated stainless steel foil for flexible electronics devices.

TYPICAL SPECIFICATIONS

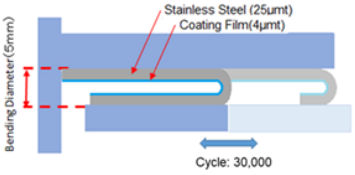
- Manufacturing Process: Roll to Roll
- Stainless Steel Foil Thickness :20~50μm
- Coating Film Thickness :2~10μm
- Width: Max. 400mm

FEATURES

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



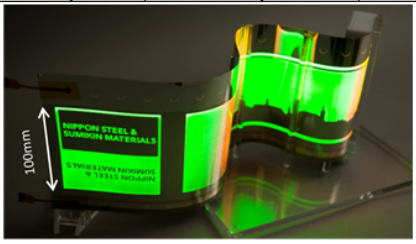
Schematic of cross section



Method of flexibility test※

Results of flexibility test

Properties	Flexibility test		
	Befor	After	Comment
Roughness Ra nm	0.6	0.6	No Change
Leakage current A/cm^2 100V	$\leqq 1^{-10}$	$\leqq 1^{-10}$	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 Organic Thin Film Device Electronics Practical Key Technology Consortium".

CONTACT

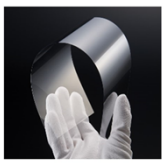
NIPPON STEEL Chemical & Material Co., Ltd..
Jun Nakatsuka
14-1, Shotokanda 4-Chome, Chiyoda-ku, Tokyo 101-0021JAPAN
E-mail nakatsuka.7zs.jun@nscm.nipponsteel.com

NIPPON STEEL Chemical & Material

Nippon Electric Glass Co., Ltd.

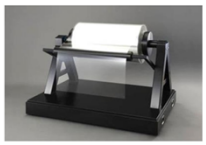
GLASS FOR FUTURE
Nippon Electric Glass

Ultra-thin Glass "G-Leaf ™ "



- G ⇨ Glass/Green
- L ⇨ Lightweight
- e ⇨ ecological/endurable
- a ⇨ advanced
- f ⇨ flexible

Alkali-free Glass	*Glass Code "OA-10G" For LCD substrate*
×	
Overflow Forming	*Surface Flatness*
×	
Ultra-thin Glass	*Under 200μm-thick*
×	
Long Rolls	*High-precision Control High Quality*



Outstanding characteristics and reliabilities

Glass properties (OA-10G)

- Optical transmittance: High transmission 92% λ = 550nm
- Electrical insulation: High resistivity > 10^{20} Ω・cm (25℃)
- Weather resistance: No deterioration by sunlight (UV)
- Thermal stability: Low CTE 3.8×10^{-6}/K
- Chemical stability: Against organic solvents acids, alkalis
- Gas barrier properties: Water vapor, O_2 Below detection limit

×

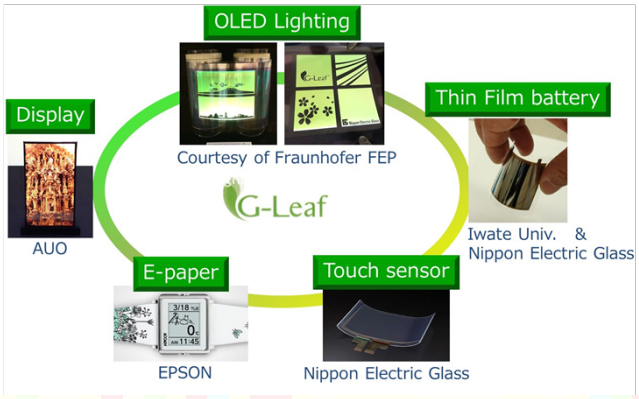
Make thinner

G-Leaf

- Flexibility
- Lightweight
- workability

Potential for new material and application

Applicable to glass roll to roll process



Thinner & lighter glass
- *Save sources*
- *Reduce energy for manufacturing and transportation*
- *Reduce wastes*
- *Creation of green processes, such as roll to roll or HF free process*

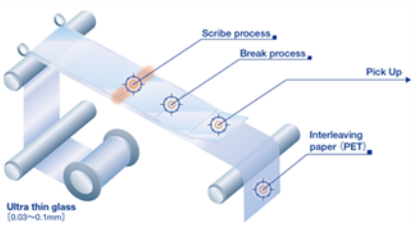
Green material
- *Hazardous substance free "OA-10G"*

Nippon Electric Glass Co., Ltd.
1-14, Miyahara 4-chome, Yodogawa-ku, Osaka 532-0003, Japan
Tel:+81-6-6399-2711 https://www.neg.co.jp/en

Ultimate high quality cutting for ultra thin glass

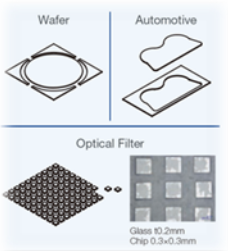
Successful solution for implementing ultra thin glass. Cutting-edge mechanical glass scriber/novel solution for minimum radius and less chipping.

Roll to sheet cutting



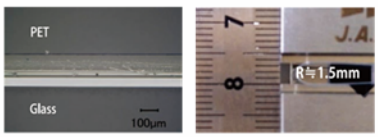
MRC

Free shape cutting



MUGP

Examples of processing



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

Features

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

Applications

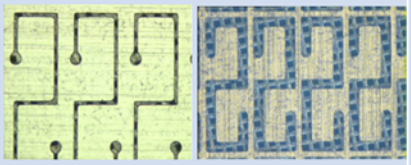
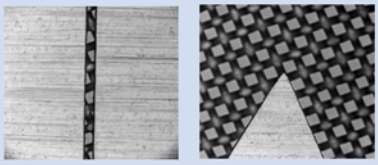
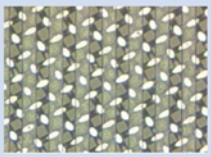
Flexible lighting, flexible display, flexible touch sensor panel, flexible PV cell, semiconductor barrier glass & interposer, small glass window, and others.

MDI MITSUBOSHI DIAMOND INDUSTRIAL CO.,LTD.

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.

Example of Screen Mask product

	MS-Mask	NE-Mask	Emulsoin-Mask(Basic Mask)
Picture	 Line width 10μm　Line width 30μm	 Line width 20μm	 Line width 30μm
	MESH:Macro-sieve 640 mesh　Thickness 8μm Image:Chip inductor image Metal film thickness　10μm	MESH:SUS304 500 mesh Thickness 26μm Image:Line & Acute Angle pattern Metal film thickness 15μm	MESH:SUS304　640 mesh　Thickness 21μm Image:Line resolution test pattern Emulsion thickness　10μm
Main Material	Non-woven electroforming mesh（nickel） Electroforming stencil（nickel）	Woven mesh(sus304) 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)	No swelling with solvent Long-time reliability and Excellent dimensional stability Woven mesh(sus304) pitch max : 900/inch	Inexpensive *Low solvent resistance

https://www.topro.com　E-mail:info@topro.com

“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)

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.

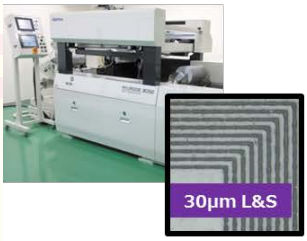
3.Expand printing business

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

RYURONE

Gapless Roll-to-roll Screen Printer

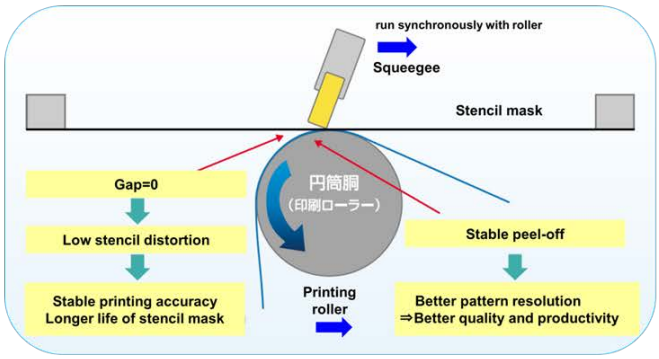
"Gap=0" makes new screen printing world



Specifications

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

Mechanism



KOMORI Group
SERIA
SERIA CORPORATION

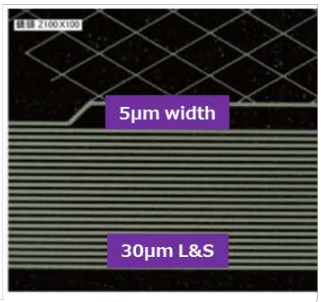
Contact information:
Eiji Iida
Overseas sales dept. (Tokyo Japan)
E-mail: iida@seria.co.jp
Phone: +81-3-3800-1050

PEPIO F6

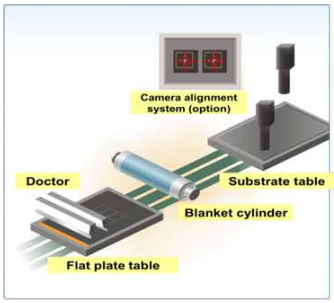
Gravure Offset Printer

Super fine line beyond screen printing

Fine line printing



Mechanism



Specifications

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

SERIA provides screen printers for printed electronics

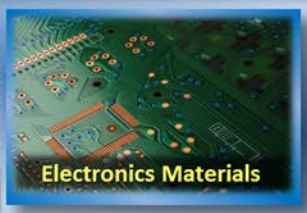
R&D screen printer for printed electronics

Vacuum screen printing machine

Double side vertical screen printing machine

FUJIKURA KASEI CO.,LTD.

Business Areas



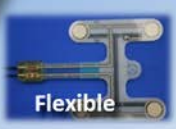
Company Profile

- Establishment : Sep. 22 1938
- Capital : 5,352 million JPY
- Employees : 397
- Sales(in Y2018) :
  (Non-consolidated) : 18,437 million JPY
  (Consolidated) : 57,431 million JPY

DOTITE Electrically Conductive Paste

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

Key Technology



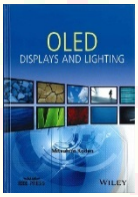
Contact Window
s-tajitu@fkkasei.co.jp
d-dewey@fkkasei.co.jp
http://www.fkkasei.co.jp/

Topics / Publications

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

- K. Taira, Taiga Suzuki, W. Konno, H Chiba, H. Itoh, M. Koden, T. Takahashi, T. Furukawa, *IDW’18*, FLX2-4L (2018). “Development of High Gas Barrier Film Using Novel Precursor by Roll to Roll PECVD”
- T. Suzuki, W. Konno, K. Taira, H Chiba, H. Itoh, M. Koden, T. Takahashi, T. Furukawa, *IDW’18*, FLXp1-10L (2018). “High Gas Barrier Films with Heterogeneous Multilayer”
- T. Furukawa, *Advanced Materials-2018（WCAM2018）* (2018). [Invited]
  “Substrates for Organic Electronics - Ultra-thin Glass, Stainless Steel Foil and High Gas”
- M. Koden, T. Furukawa, T. Yuki, H. Nakada, *LS16* (2018). [Invited]
  “Roll-to-roll and printing technologies for electrodes of flexible OLED lighting”
- 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* (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, *IWFPE2016* (2016). [Invited]
  “Flexible Substrates and Printed Transparent Electrode for OLED Lighting”

Exhibitions

- “JFlex2019” (Jan. 2019).
- “LOPEC” (March 2018, Germany).
- “Printable Electronics 2018” (Feb. 2018).
- “LED & OLED EXPO 2017” (June 2017, Korea)
- “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 Award
“Originality Award” to INOEL

“Printable electronics 2016”
(Jan. 2016)

“Printable electronics 2017”
(Feb. 2017)

“Printable electronics 2018”
(Feb. 2018)

Members

YU-FIC Fellow

Professor
Dr. Tatsuhiro Takahashi
effort@yz.yamagata-u.ac.jp

Field: Polymer chemistry, composite material
Administration, International collaboration

1988	Graduated at Waseda Univirsity (Master degree)
1988～1998	DuPont
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

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

(International conference)
- T. Furukawa, *WCAM2018* (2018). [China, Invited]
- T. Furukawa, et al., *IDW'17*, FLX6-2 (2017).
- T. Furukawa, *LED & OLED EXPO 2017* (2017). [Korea]
- T. Furukawa, et al., *LOPEC* (2017). [Germany]
- T. Furukawa, et al., *IDW/AD'16*, FLX3-3 (2016).
- T. Furukawa, *IWFPE2016* (2016). [Korea, Invited]
- T. Furukawa, et al., *ICFPE 2016*, O15-6 (2016).

YU-FIC Executive Secretary

Professor
Dr. Mitsuhiro Koden
koden@yz.yamagata-u.ac.jp
http://www.asahi-net.or.jp/~ar3t-kudn/technology.html

Field: LCD, Display, OLED, Chemistry

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)

(Award)
- Award from Minister of State for Science and Technology Policy", Cabinet Office, Government of Japan (2017).
- Award from The Japanese Liquid Crystal Society (2005).

(Development)
- 17" Ferroelectric liquid crystal display (FLCD) prototype (1999).
- 3.6" polymer OLED display with world's highest resolution (2006).

(Book)
- M. Koden, "OLED Displays and Lighting" (Wiley; IEEE Press) (2017).
- K. Takatoh, M. Hasegawa, M. Koden, N. Itoh, R. Hasegawa, M. Sakamoto, "Alignment Technologies and Applications of Liquid Crystal Devices" Taylor & Francis (2005).

YU-FIC Secretary

Mariko Hoshina
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Related section

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