

September 12, 2018

TANAKA Precious Metals

TANAKA Holdings Co., Ltd.

## TANAKA Develops 70°C Low-temperature Sintering Technology Using Silver Nano Ink and Full-surface Silver Metal Film Forming Technology Using Etching Processes

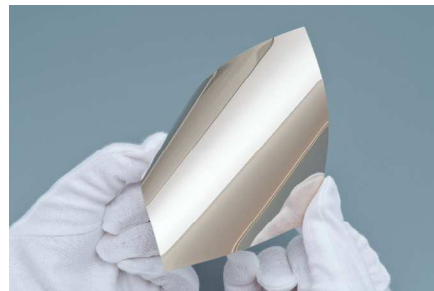
**New technologies expected to reduce thickness, increase flexibility, and enhance image quality for touch panels and organic electroluminescence displays**

TANAKA Holdings Co., Ltd. (Head office: Chiyoda-ku, Tokyo; Representative Director & CEO: Akira Tanae) announced today that TANAKA Kikinzoku Kogyo K.K. (Head office: Chiyoda-ku, Tokyo; Representative Director and CEO: Akira Tanae), which operates TANAKA Precious Metals manufacturing business, has developed **a wire forming technology (Low-temperature sintered silver nanometal printing technique) capable of sintering at a low temperature of 70°C** using TANAKA Kikinzoku Kogyo's low-temperature sintered silver nano ink, and **a full-surface silver metal film forming technology (A full-surface silver metal film forming technique) using existing etching<sup>1</sup> processes.**

This technology will contribute to thinner devices, increased flexibility, and higher image quality of smartphone touch panels, organic electroluminescence displays, and other applications.



Low-temperature sintered silver nano ink



Full-surface silver metal film

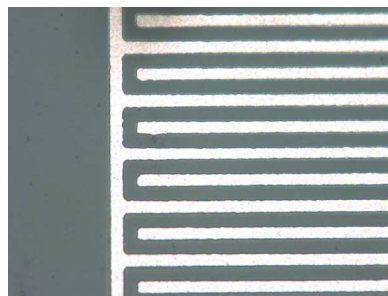
### ■ Low-temperature sintered silver nanometal printing technique: Features

- Previous silver nano ink sintering was only possible at high temperatures of 130–140°C, which made it difficult to print on organic materials such as the comparatively heat-sensitive PET film and other engineering plastic<sup>2</sup> films. However, the newly developed low-temperature sintered silver nanometal printing technique achieves a **resistance of 50 micro-ohm centimeters ( $\mu\Omega\text{cm}$ ) or less, which is equivalent to sintering at high temperatures, even at the low sintering temperature of 70°C. This has dramatically improved the freedom to choose organic materials on which to print.**
- Sintering silver nano wire circuitry at the low temperature of 70°C **does not damage materials such as organic luminescence elements<sup>3</sup> and contributes to enhanced image quality.**
- Patterns formed by low-temperature sintering **can consist of several layers to several dozen layers of silver nanoparticles to create multilayer sintered thin film structures, which is expected to provide improved bending strength (flexibility) compared to previous products.**

The combination of low-temperature sintered silver nano ink with TANAKA Kikinzoku Kogyo's SuPR-NaP<sup>4</sup> technique-based metal mesh wiring technology<sup>5</sup> enables fine wires of 4 micrometers (μm) or less to be formed on the film.

#### ■ A full-surface silver metal film forming technology: Features

- By sintering low-temperature sintered silver nano ink at 140°C, **it is possible to form full-surface silver metal films capable of etching and with an equivalent or better level of electrical resistance to that achieved by indium tin oxide (ITO)**, which is commonly used in current touch panels and other devices.
- **Capital investment and other costs can be reduced because existing etching processes can be used.**
- Silver metal mesh substrates formed with this technology have an equivalent or better level of electrical resistance to that achieved by transparent electrodes<sup>6</sup> made from indium tin oxide (ITO) etched into a glass substrate. **With improved bending strength (flexibility) and improved transparency as well, they are expected to enable enhanced image quality.**



5 micrometers (μm) pattern by photolithography

As a result of the advantages offered by these products, application in high-end smartphone touch panels, which are expected to shift to bendable displays, and uses and applications in the flexible electronic device market, which is projected to grow, and the organic electroluminescence display market, which is looking for thinner products and enhanced image quality, are expected.

---

#### 1. Etching:

Also referred to as chemical cautery. Two types, wet etching, and dry etching are used, and both are used to remove the unneeded thin film when forming wiring on a printed circuit board.

#### 2. Engineering plastics:

Mainly used in industrial applications, engineering plastics have specific enhanced functionality, such as strength and heat resistance.

#### 3. Organic luminescence elements:

This refers to organic materials that emit light in response to stimulation by certain types of energy. Also referred to as organic electroluminescence elements or organic light-emitting diodes (OLED).

#### 4. SuPR-NaP technique:

On a substrate (PET film, etc.) coated with liquid-repellent fluororesin, silver nano ink reacts to parts that are modified with deep ultraviolet light. Then, silver nanoparticles undergo chemisorption so that the silver nanoparticles fuse to each other and form wiring.

#### 5. TANAKA Kikinzoku Kogyo's metal mesh wiring technology:

Metal mesh is a wiring format in a grid pattern that uses silver or copper for sensor wires rather than indium tin oxide (ITO). TANAKA Kikinzoku Kogyo developed this technology under consignment from April 2014 to September 2017 based on the SuPR-NaP fine wire forming technology resulting from research conducted by Professor Tatsuo Hasegawa, Principal Research Manager at the Flexible Electronics Research Center of the National Institute of Advanced Industrial Science and Technology, and others. Development was consigned to TANAKA Kikinzoku Kogyo under the Joint Industry-Academia Practical Application Development Project (NexTEP).

#### 6. Transparent electrodes:

These electrodes are used in electronic display devices such as LCD displays, organic electroluminescence displays, touch panels, and organic photovoltaic displays. In all cases, the use of etched indium tin oxide (ITO) on glass or other substrates is in wide use.

### ■TANAKA Holdings Co., Ltd. (Holding company of TANAKA Precious Metals)

Headquarters: 22F, Tokyo Building, 2-7-3 Marunouchi, Chiyoda-ku, Tokyo

Representative: Akira Tanae, Representative Director & CEO

Founded: 1885

Incorporated: 1918\*

Capital: 500 million yen

Employees in consolidated group: 5,034 (FY2017)

Net sales of consolidated group: 976,613 million yen (FY2017)

Main businesses of the group:

Strategic and efficient group management and management guidance to group companies as the holding company at the center of the TANAKA Precious Metals.

Website: <http://www.tanaka.co.jp/english> (TANAKA Precious Metals),

<http://pro.tanaka.co.jp/en> (Industrial products)

\* TANAKA Holdings adopted a holding company structure on April 1, 2010.

### ■TANAKA Kikinzoku Kogyo K.K.

Headquarters: 22F, Tokyo Building, 2-7-3 Marunouchi, Chiyoda-ku, Tokyo

Representative: Akira Tanae, Representative Director & CEO

Founded: 1885

Incorporated: 1918

Capital: 500 million yen

Employees: 2,246 (as of March 31, 2018)

Sales: 827,040.201 million yen (FY2017)

Main businesses:

Manufacture, sales, import and export of precious metals (platinum, gold, silver, and others) and various types of industrial precious metals products.

Website: <http://pro.tanaka.co.jp/en>

#### <About the TANAKA Precious Metals>

Since its foundation in 1885, the TANAKA Precious Metals group has built a diversified range of business activities focused on precious metals. TANAKA is a leader in Japan regarding the volumes of precious metals handled. Over the course of many years, TANAKA Precious Metals has not only manufactured and sold precious metal products for industry but also provided precious metals in such forms as jewelry and resources. As precious metals specialists, all Group companies within and outside Japan work together with unified cooperation between manufacturing, sales, and technological aspects to offer products and services. Besides, to make further progress in globalization, TANAKA Kikinzoku Kogyo welcomed Metalor Technologies International SA as a member of the Group in 2016.

As precious metal professionals, TANAKA Precious Metals will continue to contribute to the development of an enriching and prosperous society.

The five core companies in the TANAKA Precious Metals are as follows.

- TANAKA Holdings Co., Ltd. (pure holding company)
- TANAKA Kikinzoku Kogyo K.K.
- TANAKA Denshi Kogyo K.K.
- Electroplating Engineers of Japan, Limited
- TANAKA Kikinzoku Jewelry K.K.