PRESS RELEASE

April 16, 2018

Tanaka Precious Metals

Tanaka Holdings Co., Ltd.

TANAKA Confirms Improvement in Bending Durability of Flexible Touch Panels With Single-Sided, Dual-Layer Wiring Structure Metal Mesh Film

New technology is expected to enhance image quality, reduce thickness, increase flexibility, and improve durability of smart phone touch panels and other products

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 the Tanaka Precious Metals manufacturing business, discovered a single-sided, dual-layer wiring structure for metal meshes[1] used in touch sensors and a method of manufacturing the structure and has commenced development for commercial application.
This technology will contribute to higher image quality, thinner devices, increased flexibility, and improved durability of smart phone touch panels and other applications.

Touch panels normally have a structure made from two sensor substrates—an X sensor substrate and a Y sensor substrate. Tanaka Kikinzoku Kogyo discovered a technique for forming both the X sensor and Y sensor wiring on a single layer flexible substrate. The discovery was based on the results of 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. Development was consigned to Tanaka Kikinzoku Kogyo under the Joint Industry-Academia Practical Application Development Project (NexTEP). The discovery was made by applying the metal mesh wiring technology developed under consignment from April 2014 to September 2017 and forming overlapping silver nano-ink wire circuity on one side of the film (creating a single-sided, dual-layer metal mesh film). As a result, only one sensor substrate is needed. This will contribute to reducing costs as well as improving touch panel image quality and making panels slimmer. Tanaka Kikinzoku Kogyo also discovered a transparent (conducting) electrode formed by etching[2] indium tin oxide (ITO), which is commonly used in current touch panel sensors, on a glass substrate and created a structure expected to **improve bending strength (increased flexibility)** that even metal mesh films cannot withstand as well as a method of manufacturing this structure.

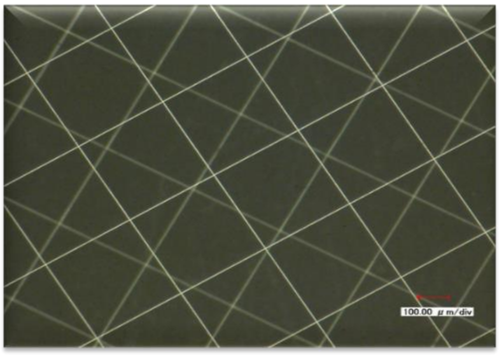
■ Features of the New Technology

・Single-sided, dual-layer structure contributes to slimness and improved bending strength (improved flexibility).

・By using a low temperature sintered silver nano-ink[3] and an SuPR-NaP technique[4] for pattern formation instead of etching, fine wires less than 4 um (2 um – 4 um) can be formed.

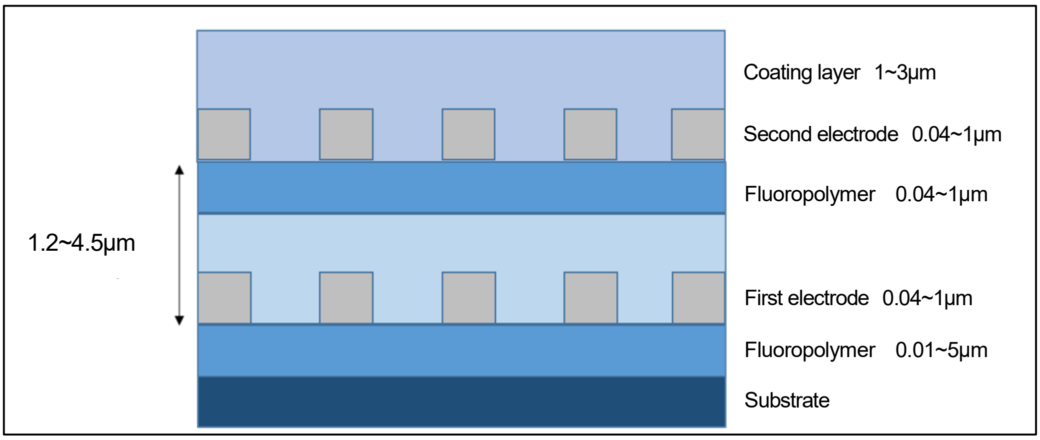
・Long films can be produced using a roll-to-roll process.[5]

As a result of these advantages offered by this product, application in high-end smart phone 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, are expected.



Enlarged exterior view of the metal mesh film with a single-sided, dual-layer wiring structure for use in touch sensors

Rendering of a representative final product using a single-sided, dual-layer structure mesh film (a bendable smart device)



Cross section view of the metal mesh film with a single-sided, dual-layer wiring structure for use in touch sensors

■ Tanaka Kikinzoku Kogyo's Metal Mesh Film Printing Technology

Tanaka Kikinzoku Kogyo's metal mesh film printing technology can create fine wires thinner than 4 um. This is accomplished by applying **<u>low-temperature sintered silver nano-ink</u>** that can be formed into wires on PET film, which is not heat resistant, and fluoropolymer on a PET film or second substrate, causing adsorption and sintering of silver nano-ink on a fluoropolymer surface activated by irradiation with deep ultraviolet light, and using a SuPR-NaP (Surface Photo-Reactive Nanometal Printing) technique. In addition, Tanaka Kikinzoku Kogyo established a manufacturing process for the fine-wire film using a **<u>roll-to-roll processing method</u>**. This makes possible bulk printing of metal mesh films with mixed patterns ranging from several microns to tens of microns, sensor units, and frame parts. Tanaka Kikinzoku Kogyo is currently offering samples of metal mesh films with standard specifications (4 um, single-sided, single-layer structure) and is conducting research and development with the aim of providing sample shipments of single-sided, dual-layer structure metal mesh films in the future.

■ Background to Development

High-end smart phones with foldable displays and other components are expected to appear in the marketplace starting 2019 to 2020, and there is a need to create thinner and highly durable flexible touch panels.

Currently, high-transparency, projection-capacitive[6] type touch panels with multi-touch functionality (detection of multiple points) are commonly used in smart phones. Because of the high transparency and for considerations of mass production, the touch sensors in projection-capacitive type touch panels generally use transparent electrodes made from indium tin oxide (ITO) etched into a glass substrate. Research is currently being conducted, however, to find replacements for ITO because of difficulties reducing prices in the future and environmental concerns raised by waste liquids generated during the etching process. In addition, ITO has high electrical resistance and is weak when bent making large and flexible panels difficult, and consequently, it is not suitable for the future smart phone market.

Accordingly, companies are developing sensors for touch panels using metal meshes, and they are already in use in some touch panel displays and PCs. The most common wire width of metal meshes currently in use is 3 um to 7 um, and the wiring portions are within the range of human vision, posing an issue regarding widespread use in smart phones and other devices that are used at close distances.

Tanaka Kikinzoku Kogyo achieved fine wire formation smaller than 4 um, which was thought to be difficult, by adopting a low-temperature sintered silver nano-ink and a SuPR-NaP technique. In addition, by using this technique with a roll-to-roll format, mass production using bulk printing of sensor units and frame parts as well as cost reductions will be possible. By using the wiring technology discussed above, the outlook for single-sided, dual-layer wiring structure metal mesh films for use in touch sensors is now positive, and contributions to further development in the market for next-generation bendable and foldable smart phones that consumers want as well as the market for flexible electronic devices can be expected.

Reference: Results of Single-Sided, Dual-Layer Structure Metal Mesh Film Bending Tests

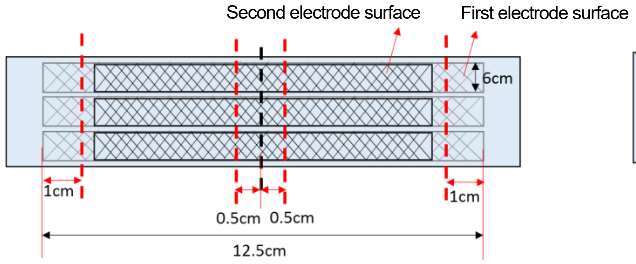
Conditions
Bending radius : 2mm
Base material : PET 50μm
Number of bends : 100,000 times
Wire thickness : 0.08μm

		Resistance value (kΩ)								
		Wire width 1μm			Wire width 2μm			Wire width 5μm		
		Zero times	100,000 times	Change	Zero times	100,000 times	Change	Zero times	100,000 times	Change
Single-sided, dual-layer	First electrode surface	8.55	9.30	0.75	6.8	7.05	0.25	4.40	4.45	0.05
	Second electrode surface	1.15	2.20	1.05	0.97	1.3	0.33	0.6	0.69	0.09
Both sides	First electrode surface (top side)	10.27	11.1	0.83	6.95	7.17	0.22	3.83	3.9	0.07
	Second electrode surface (bottom side)	1.85	8.23	6.38	1.35	3.45	2.1	0.65	1.55	0.90

The resistance of the metal wires after the bending test tended to increase overall, but the degree of the increase in the resistance value of the metal wire on the two-sided structure second electrode surface (bottom side) was conspicuous. Also, even when the wire width on the test prototype was changed to 1 um, 2 um, or 5 um, the two-sided structure was weak when bent, and it was determined that the single-sided, dual-layer structure is resistant to bending deformation.

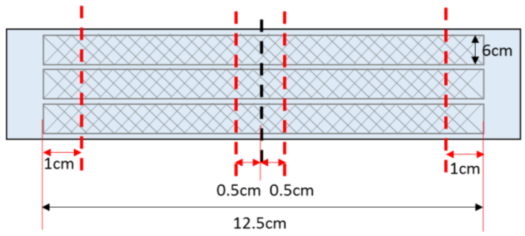
Measurement Conditions

Single-sided, dual-layer structure



Measurements were taken using a tester 1 cm from both edges of the first electrode surface and on both sides are a 0.5 cm from the central wire of the second electrode surface substrate.

Two-sided structure



Measurements were taken using a tester 1 cm from both edges of the first electrode surface (topside) and on both sides are a 0.5 cm from the central wire of the second electrode surface (bottom side) substrate.

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1. Metal mesh:

A wiring format in a grid pattern that uses silver or copper for sensor wires rather than etching with indium tin oxide. When forming wires on the micrometer level, a surface with a photosensitive material applied is irradiated in the pattern, resulting in the formation of a pattern according to the areas that were irradiated in those areas that were not irradiated (photolithography technology), and as a result, it is believed that reducing costs with this technology would be difficult.

2. Etching:

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

3. Low-temperature sintered silver nano-ink:

Proprietary Tanaka Kikinzoku specialty silver nano-ink that is sintered at temperatures below 100° C. Includes a high concentration of silver nanoparticles with diameters in the range of 10 nm to 100 nm (1 nanometer equals one-billionth of a meter).

4. SuPR-NaP technique:

A technology for forming wires where a substrate (PET film, etc.) with a water repellent fluoropolymer applied is irradiated with deep ultraviolet light and silver nano-ink reacted with silver nanoparticles is chemically absorbed and the silver nanoparticles also adhere to one another.

5. Roll-to-roll process

A production process where circuits are printed on a film substrate wound into a roll and the roll is rewound. This method allows for high-efficiency production of electronic devices.

6. Projection-capacitive type

Formed from an insulating film, an electrode layer below the film, and a substrate layer on which the controller IC is mounted. Numerous electrode patterns are formed on a glass, plastic, or other substrate using transparent electrodes and other such components on the insulating film and the electrode layer below it.

■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: 5,120 (FY2016)
Net sales of consolidated group: 1,064,259 million yen (FY2016)
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: 2,269 (as of March 31, 2017)
Sales: 1,059,003,329 million yen (FY2016)
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.

<Press inquiries>
Tanaka Holdings Co., Ltd.
https://www.tanaka.co.jp/en/protanaka/inquiry/index.php