

April 7, 2015

Tanaka Precious Metals  
Tanaka Holdings Co., Ltd.

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## Establishment of Mass Production System for Textured Cu Metal Substrates Using YBCO Superconducting Wire

Stability and elongation achieved by means of thin film that includes palladium

Annual sales target of 1.2 billion yen by 2020

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Tanaka Holdings Co., Ltd. (Head office: Chiyoda-ku, Tokyo; Representative Director & CEO: Akira Tanae) today announced that Tanaka Kikinzoku Kogyo K.K. (Head office: Chiyoda-ku, Tokyo; Representative Director & CEO: Akira Tanae) has constructed exclusive production lines for textured Cu metal substrates for YBCO superconducting wire <sup>(\*)</sup> and has established mass production systems for use starting April 2015.

In October 2008, Tanaka Kikinzoku Kogyo together with Chubu Electric Power and Kagoshima University jointly developed the first ever textured Cu metal substrates using superconducting wire. Production began and samples were distributed from December of the same year. This superconducting wire replaces the use of Ni alloys (nickel and tungsten alloys), which were formerly the primary materials for textured metal substrates, with low-cost and high orientation <sup>(\*\*)</sup> copper, thereby reducing costs by more than 50%. One of the weaknesses of copper is its susceptibility to oxidation, which can cause the thin film (superconducting wire or oxide buffer layer) formed on the substrate to become detached. However, the orientation and the surface smoothness is increased through the use of a special nickel plating solution that contains palladium as the oxygen metal barrier layer, which improves the deposition stability of the thin film on the substrate.

Since samples of the textured Cu substrates were first sent out, Tanaka Kikinzoku Kogyo has continued to carry out research to verify deposition stability. The production of elongated substrates has now become possible through the optimization of equipment conditions. In order to respond to domestic and international demand immediately, an exclusive production line was constructed at a company-owned plant in April 2015. It is expected that this technology will be put to use in various other fields in the future including long-distance and high-capacity electricity supply cables, Magnetic Resonance Imaging (MRI) and Nuclear Magnetic Resonance (NMR), which require high magnetic fields, and motors for large ships. Tanaka Kikinzoku Kogyo is aiming to achieve annual sales of 1.2 billion yen by the year 2020.

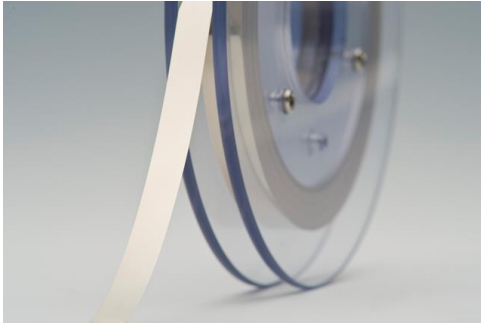
A sample display of this substrate using superconducting wire will be exhibited at the 2<sup>nd</sup> High-function Metal Expo between April 8 and April 10, 2015, at Tokyo Big Sight.

**\*1 YBCO superconducting wire**

Superconducting materials processed for use as a wire that achieves zero electrical resistance. It is formed of yttrium, barium, copper and oxygen.

**\*2 Orientation**

This indicates the degree of uniformity in the orientation of crystals. A greater degree of superconductivity can be obtained by arranging the crystals at regular intervals.



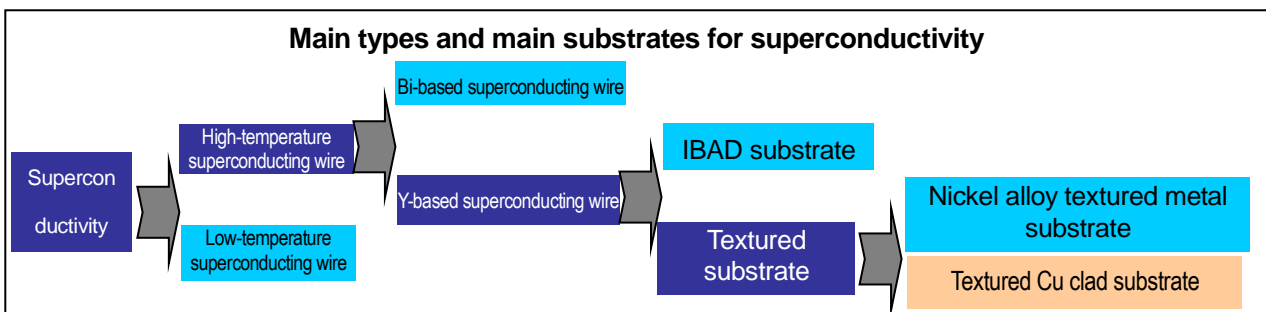
Textured Cu substrates are composed of three layers (thickness of 0.1mm, width of 10mm)

**<Supplementary material>**

**■Types and characteristics of superconducting wire**

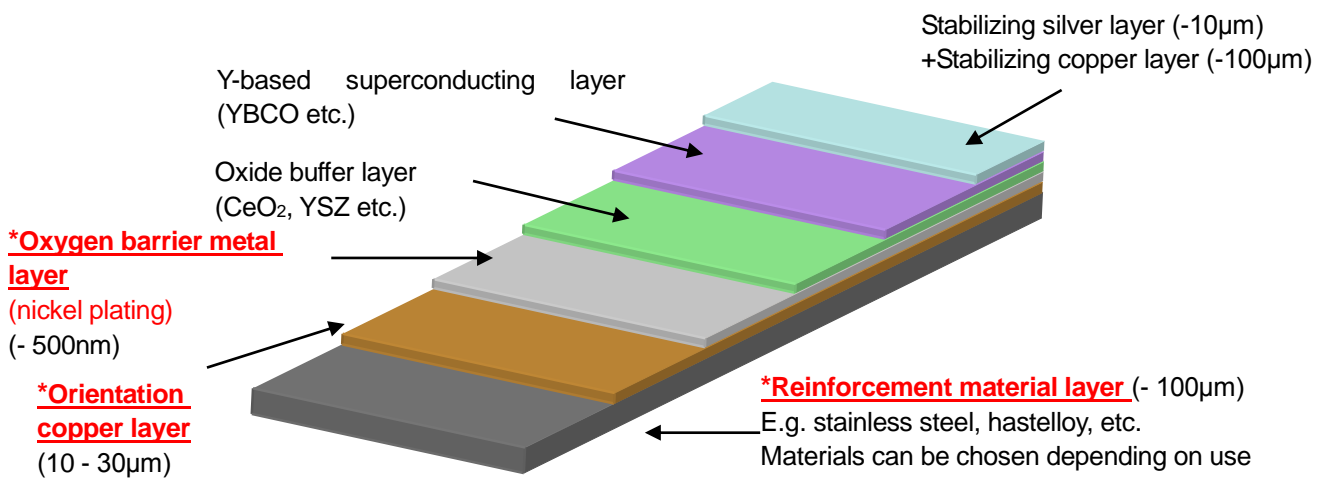
Superconducting wires have the characteristic of producing powerful magnetic fields when coiled. They are classified according to critical temperature (the temperature at which they achieve superconductivity). The two types are “high-temperature superconducting wire,” which maintains superconductivity at -196°C or below, and “low-temperature superconducting wire,” which maintains superconductivity at -250°C or below. In comparison to low-temperature superconducting wire, which is already being used for MRI, NMR, linear motorcars and more, high-temperature superconducting wire has a higher critical current density (size of electric current), lowers costs by using liquid nitrogen for cooling, and reduces susceptibility to the effects of external magnetic fields, so the development of high-temperature superconducting wire is currently being promoted.

There are bismuth-based (referred to as “bi-based” below) and yttrium-based (referred to as “Y-based” below) high-temperature superconducting wires. Bi-based are filled in a silver pipe which is processed in order to make it usable as a wire, while Y-based are disposed on a substrate in a tape format with aligned crystals in order to be used as a wire. Y-based is expected to be the next-generation of superconducting wire as it has a particularly high critical current density, strong magnetic field characteristics, and the cost of materials can be lowered by reducing the amount of silver used.



## ■Characteristics of Y-based superconducting wire substrates and technical development at Tanaka Kikinzoku Kogyo

With regard to Y-based superconducting wire substrates, we are carrying out R&D for “IBAD substrates” and “textured substrates.” Superconductivity characteristics are increased by arranging the metal crystals at regular intervals, so the orientation processing of the metal must be processed on each layer that forms the tape. For IBAD substrates, an oxide thin film layer is oriented in a specific direction on a non-oriented high strength metal, and a superconducting layer is disposed on the substrate using a laser, which creates a strong substrate material, but it also raises the issue of the cost of the equipment and materials. This is why Tanaka Kikinzoku Kogyo has focused on textured substrates. Costs are reduced by using high-orientation copper as the substrate material, which also increases mechanical strength when combined with a reinforcement material layer using clad technology that does not affect orientation.



### Structure of textured Cu metal substrate using Y-based superconducting wire

**The three layers in red text** form the substrate offered by Tanaka Kikinzoku Kogyo, on top of which the Y-based superconducting wire is formed from the oxide buffer layer, the Y-based superconducting layer, and the stabilizing silver/copper layers. This metallic wire has a thickness of approximately 0.1mm.

■**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: 3,562 (FY2013)

Net sales of consolidated group: 967.6 billion yen (FY2013)

Main businesses of the group:

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

Website: <http://www.tanaka.co.jp/english> (Tanaka Precious Metals),  
<http://pro.tanaka.co.jp/en> (Industrial products)

■**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: 1,430 (FY2013)

Sales: 929 billion 60 million yen (FY2013)

Main businesses:

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

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

**<About the Tanaka Precious Metals>**

Established in 1885, the Tanaka Precious Metals has built a diversified range of business activities focused on the use of precious metals. On April 1, 2010, the group was reorganized with Tanaka Holdings Co., Ltd. as the holding company (parent company) of the Tanaka Precious Metals. In addition to strengthening corporate governance, the company aims to improve overall service to customers by ensuring efficient management and dynamic execution of operations. Tanaka Precious Metals is committed, as a specialist corporate entity, to providing a diverse range of products through cooperation among group companies.

Tanaka Precious Metals is in the top class in Japan in terms of the volume of precious metal handled, and for many years the group has developed and stably supplied industrial precious metals, in addition to providing accessories and savings commodities utilizing precious metals. As precious metal professionals, the Group will continue to contribute to enriching people's lives in the future.

The eight core companies in the Tanaka Precious Metals are as follows.

- Tanaka Holdings Co., Ltd. (pure holding company)
- Tanaka Kikinzoku Hanbai K.K.
- Tanaka Denshi Kogyo K.K.
- Tanaka Kikinzoku Jewelry K.K.
- Tanaka Kikinzoku Kogyo K.K.
- Tanaka Kikinzoku International K.K.
- Electroplating Engineers of Japan, Limited
- Tanaka Kikinzoku Business Service K.K.