Characteristics of The New Pd-based Alloy for Probe-pins, TK-FS, which has three unique features: High Hardness/High Electrical Conductivity/High Ductility

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4th Annual SWTest Asia | Hsinchu, Taiwan, November 2-3, 2023

Outline

- ABOUT TANAKA PRECIOUS METALS
- Probe-pins types required in semiconductor manufacturing process
- Characteristics of materials required for each types of Probe-pins
- Characteristics of The New Pd-based Alloy for Probe-pins, TK-FS
- Manufacturing process of TK-FS

ABOUT TANAKA PRECIOUS METALS

Group Network

TANAKA HOLDINGS Co., Ltd.

Strategic and efficient group management and management group companies as the holding company at the center of the TANAKA PRECIOUS METALS.

TANAKA KIKINZOKU KOGYO K.K.

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

TANAKA DENSHI KOGYO K.K.

Manufacturing of various holding wires, and provision of technical services globally.

EEJA Ltd.

Development, manufacture, sales and export of precious metal and base metal plating solutions, additives and surface treatment-related chemicals.

Metalor Technologies International SA

Precious metals recovery and refining, production and sales of electrical contacts, and production and sales of plating solutions and plating equipment.

TANAKA KIKINZOKU JEWELRY K.K.

Retailing of gold and platinum jewelry, diamond jewelry, bridal jewelry and precious metals art objects, selling and buying of gold and platinum bullion bars and coins, remodeling and recycling used jewelry (RE:TANAKA).

ABOUT TANAKA PRECIOUS METALS

1885

Started Money Exchange business as "Tanaka Shoten" in Tokyo

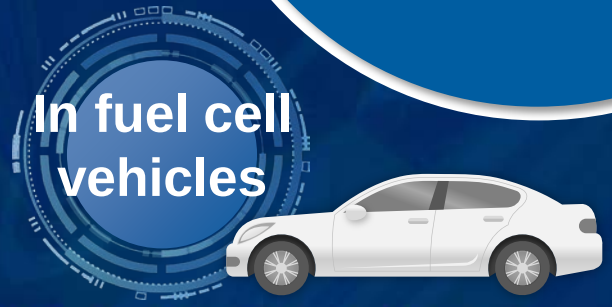
2022

680 Billion JPY

Net sales (consolidated)

5,355

Employees (consolidated)

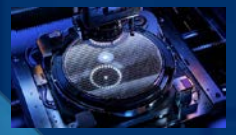


Probe-pins types required in semiconductor manufacturing process

Design

Front-end process

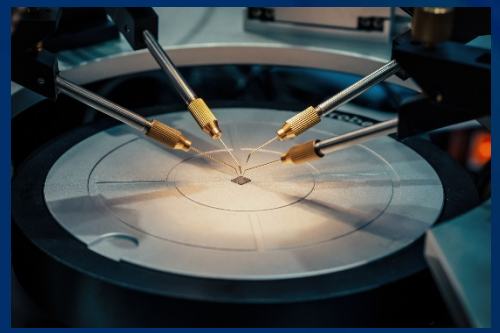
Oxide film/ thin film formation



Resist coating

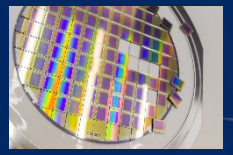
Exposure/ etching

Ion implantation/ wiring formation



Wafer test

Cantilever-type
Vertical-type
Wire-probe



Dicing

Back-end process

Mounting

Bonding

Molding

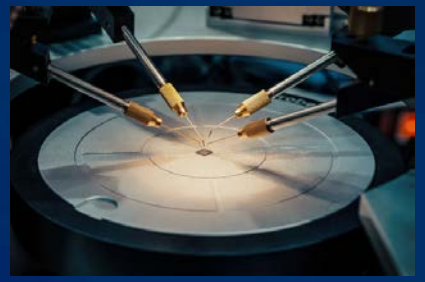
Final test

Pogo pin Type

Characteristics of materials required for each types of Probe-pins

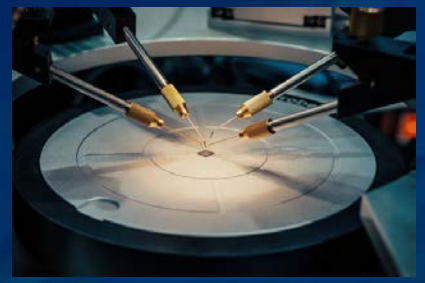
Cantilever
（Wafer test）

- High Electrical Conductivity
- High Ductility



Vertical
（Wafer test）

- High Hardness（Long life）
- High Electrical Conductivity



Pogo pin
（Final test）

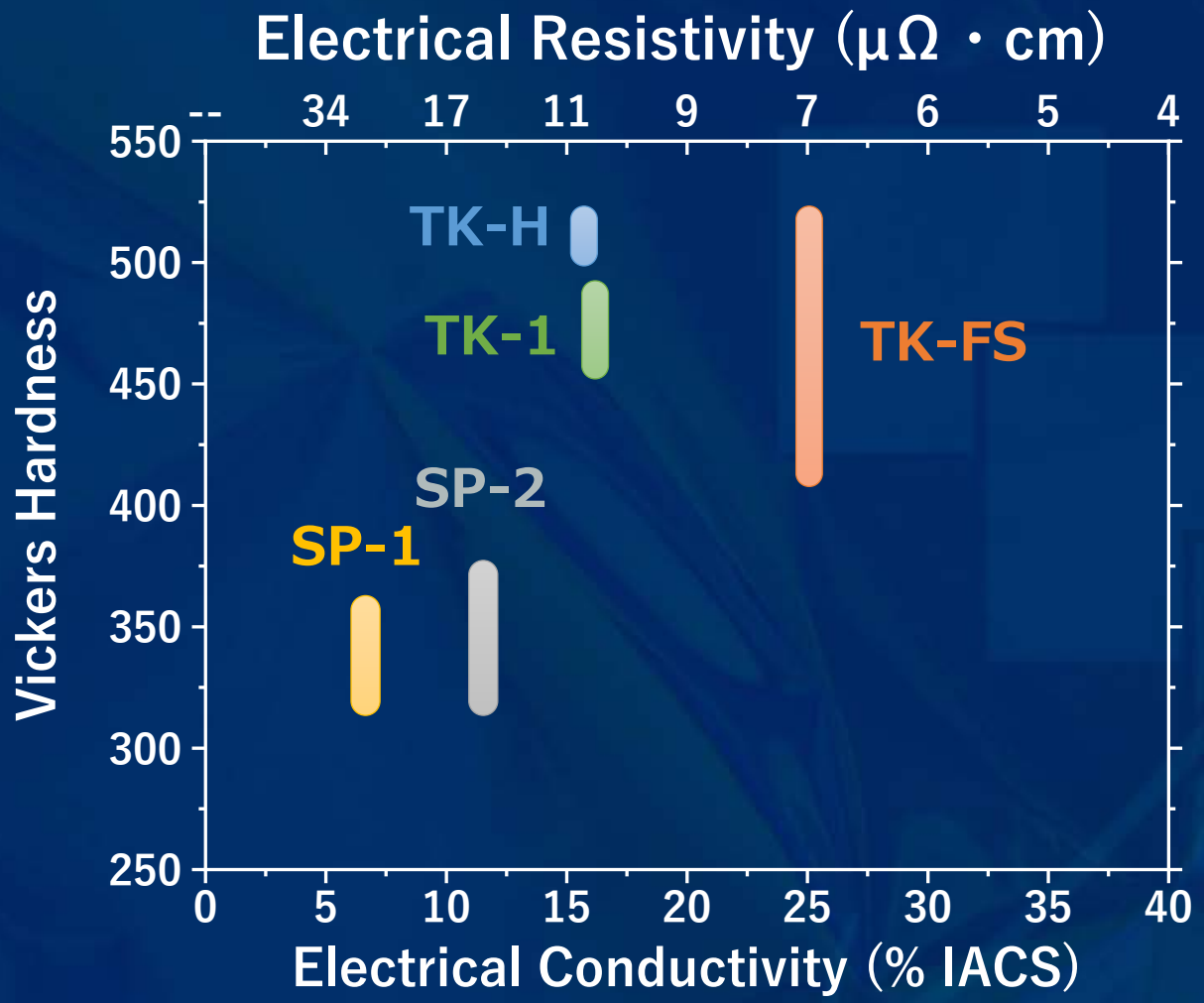
- High Hardness（Long life）

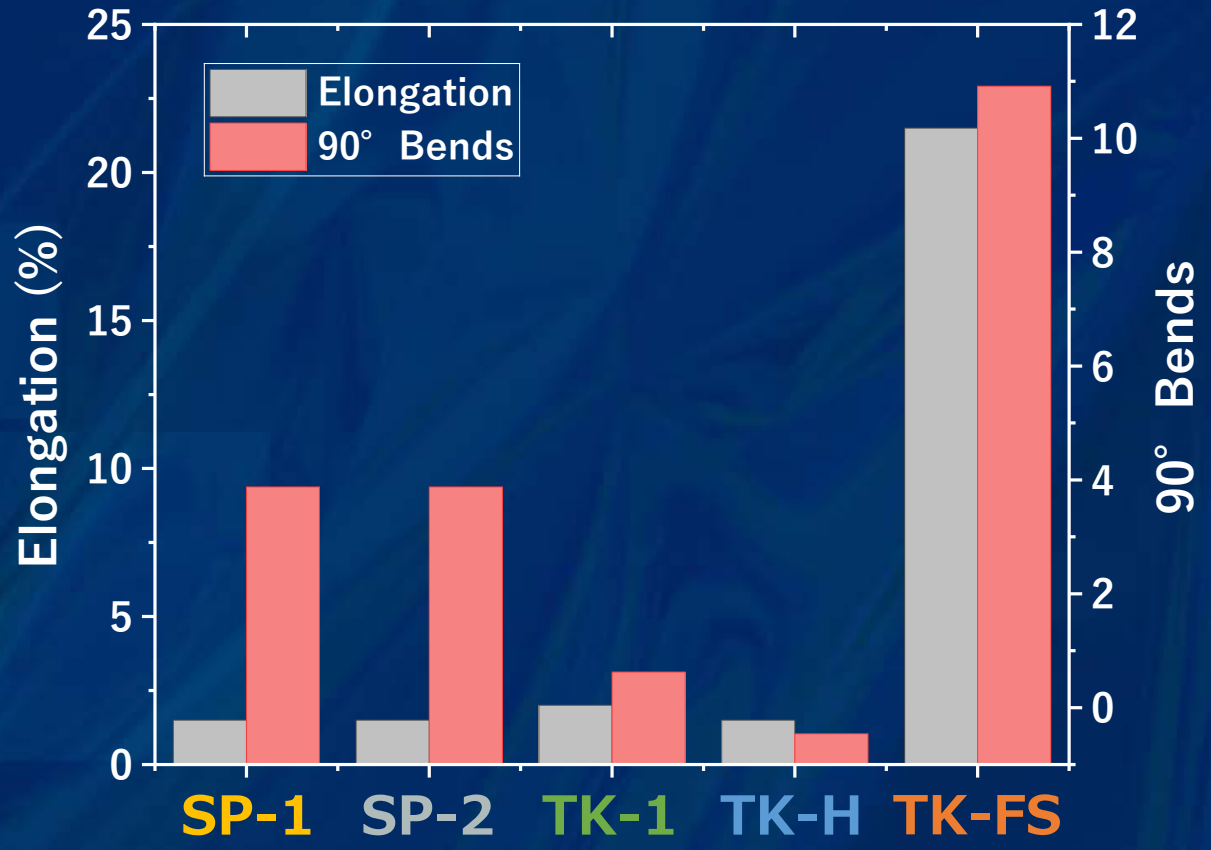
Major Materials for Probe-pins at TANAKA PRECIOUS METALS

	SP-1 (Pd-Ag-Cu-Pt-Au)	SP-2 (Au-Ag-Cu-Pt)	TK-1 (Pd-Ag-Cu)	TK-H (Pd-Ag-Cu)	**TK-FS* (Pd-Ag-Cu)**	Rh*	Ir*
Hardness (HV)	300-350	300-360	460-490	500-520	**400-520**	400-550	500-750
Young's modulus (GPa)	112	106	110	112	**150**	380	530
Electrical Conductivity (%IACS)	6.9	13.3	16.6	16.3	**25-29**	35.9	30.8
Elongation at failure (%)	1-2	1-2	1-3	1-2	**13-30**	1-2	1-2
90° Bends (times)	3-6	3-6	1-2	0-1	**8-14**	-	-

*Patent registered

Comparison of Major Materials for Probe-pins





Characteristics of The New Pd-based Alloy for Probe-pins, "TK-FS"

Conductivity

25-29%IACS

TK-1: 16.6%IACS

Hardness

(**Adjustable widely**)

Max.**520 H V**

～Min. 400HV

TK-1:460-490HV

Ductility

EL: **13-30%**

90°Bends: **8-14**

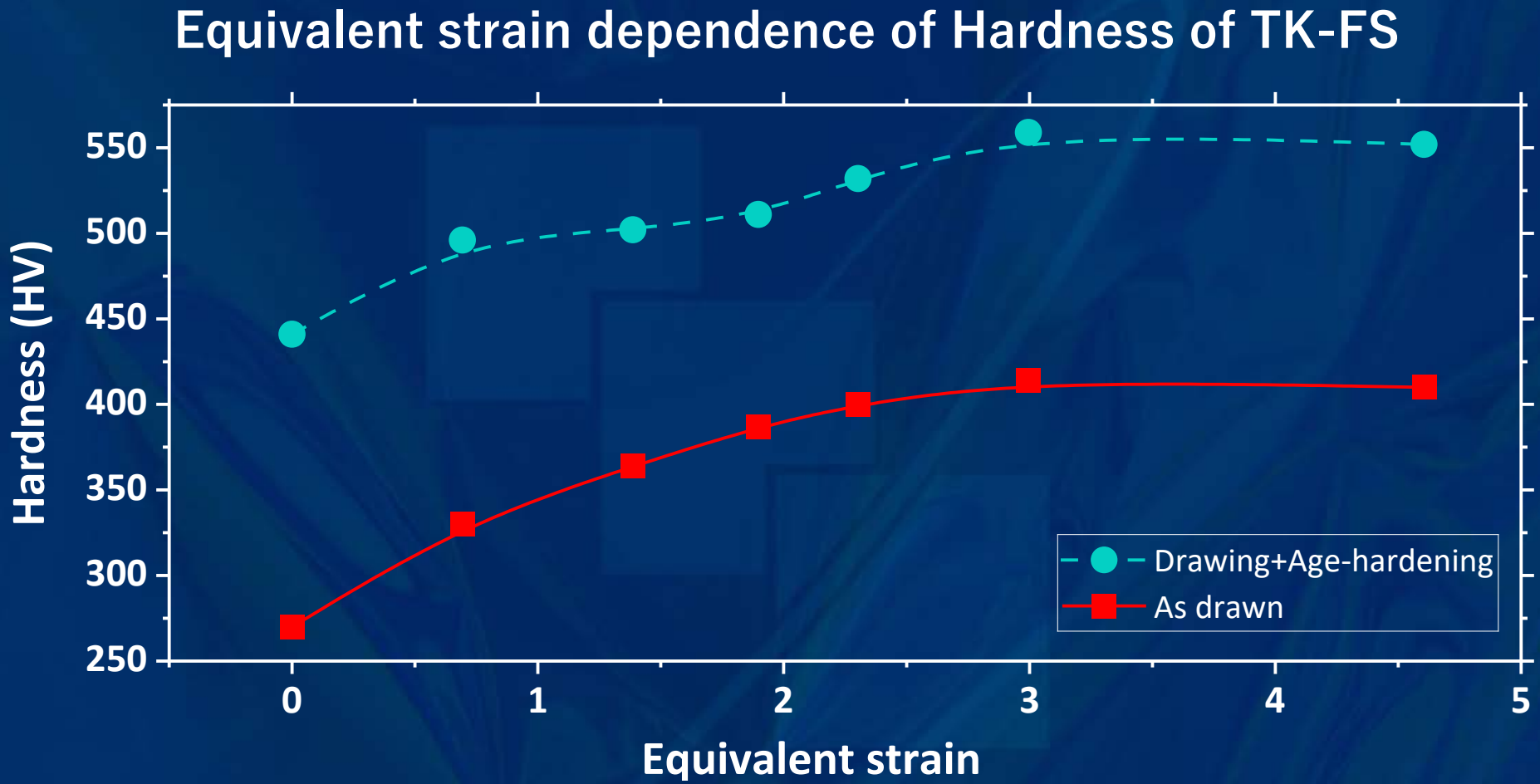
TK-1:

EL: 1-3%

90°Bends: 1-2

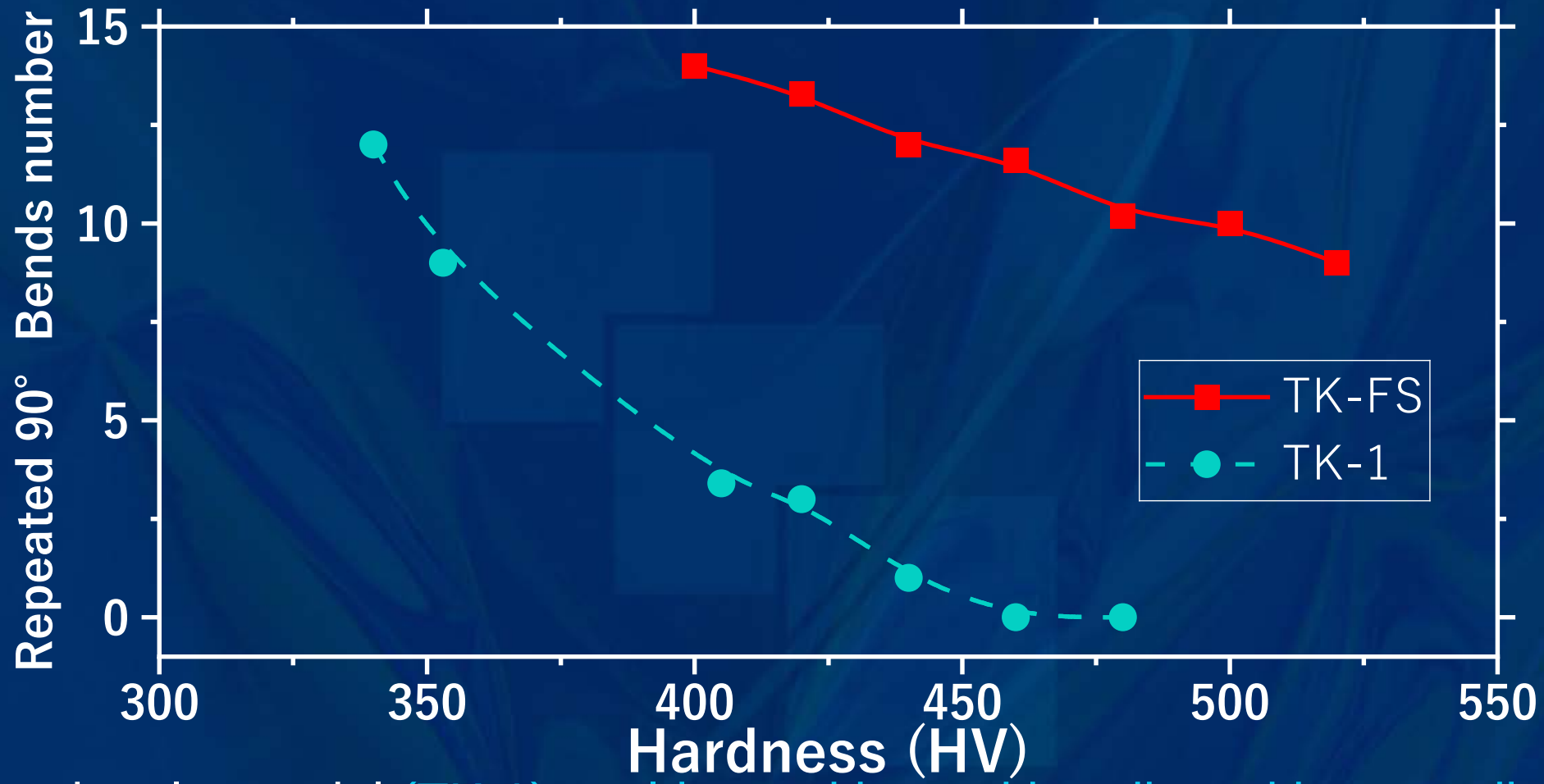
TK-FS can be applied to various types of Probe-pins

Work hardening behavior of “TK-FS”



TK-FS becomes harder with increasing Equivalent strain, saturating in hardness at 3 or higher.

Hardness vs 90° Bends (comparison of “TK-FS” and TK-1)



The conventional material (TK-1) could not withstand bending with exceeding 450HV.
However, TK-FS exhibits **excellent bending durability even over 500HV**.

Wear test

Test Condition

Probe Material: TK-FS/TK-H/TK-1

Probe Dimension: φ0.93mm×16mmL

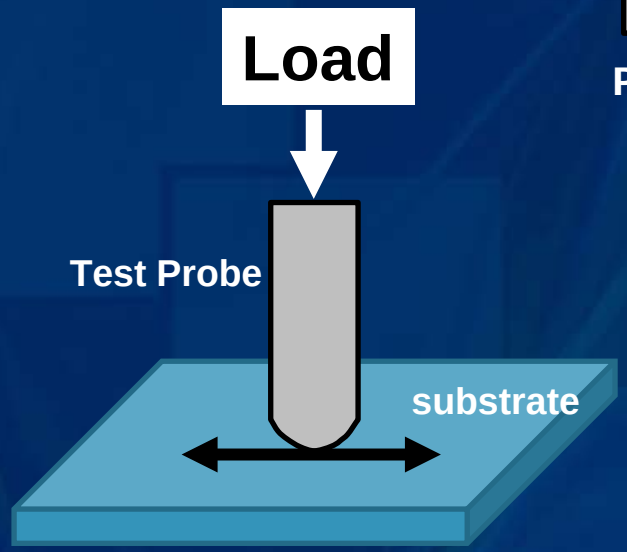
Probe Tip Shape: SR0.03-0.05

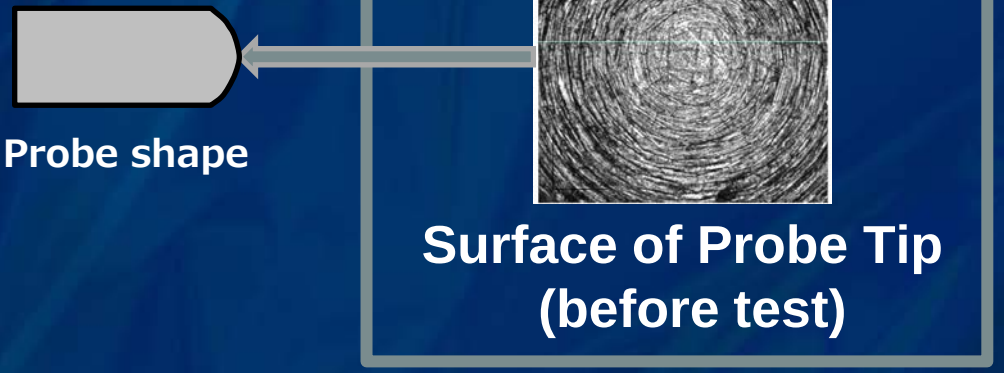
Stroke: About 1mm

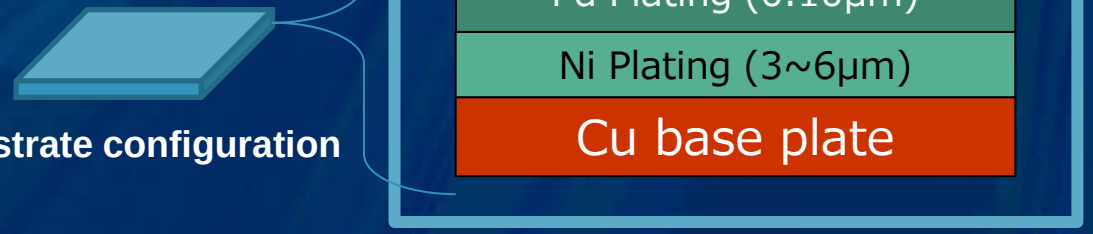
Test Speed: 20mm/sec (10Hz)

Test Load: 20, 40gf

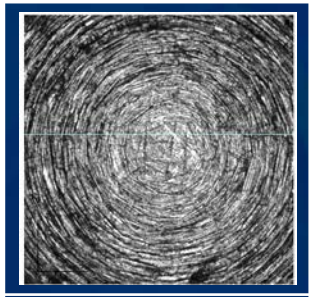
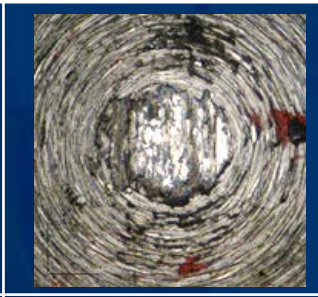
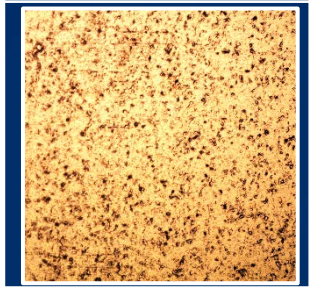
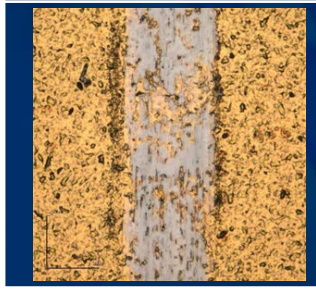
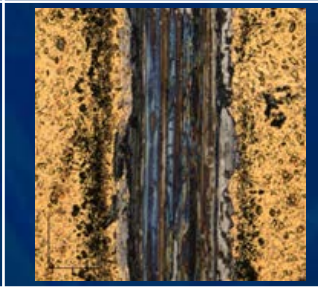
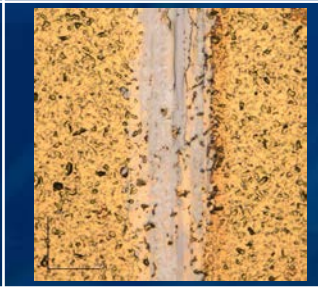
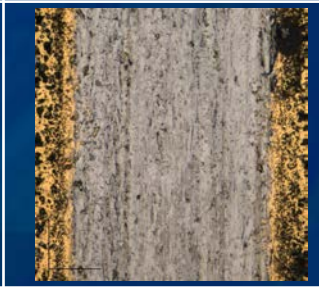
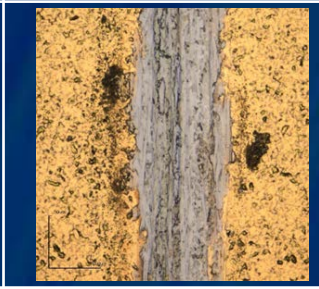
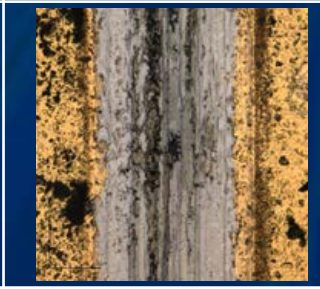
Test Temperature: R.T.



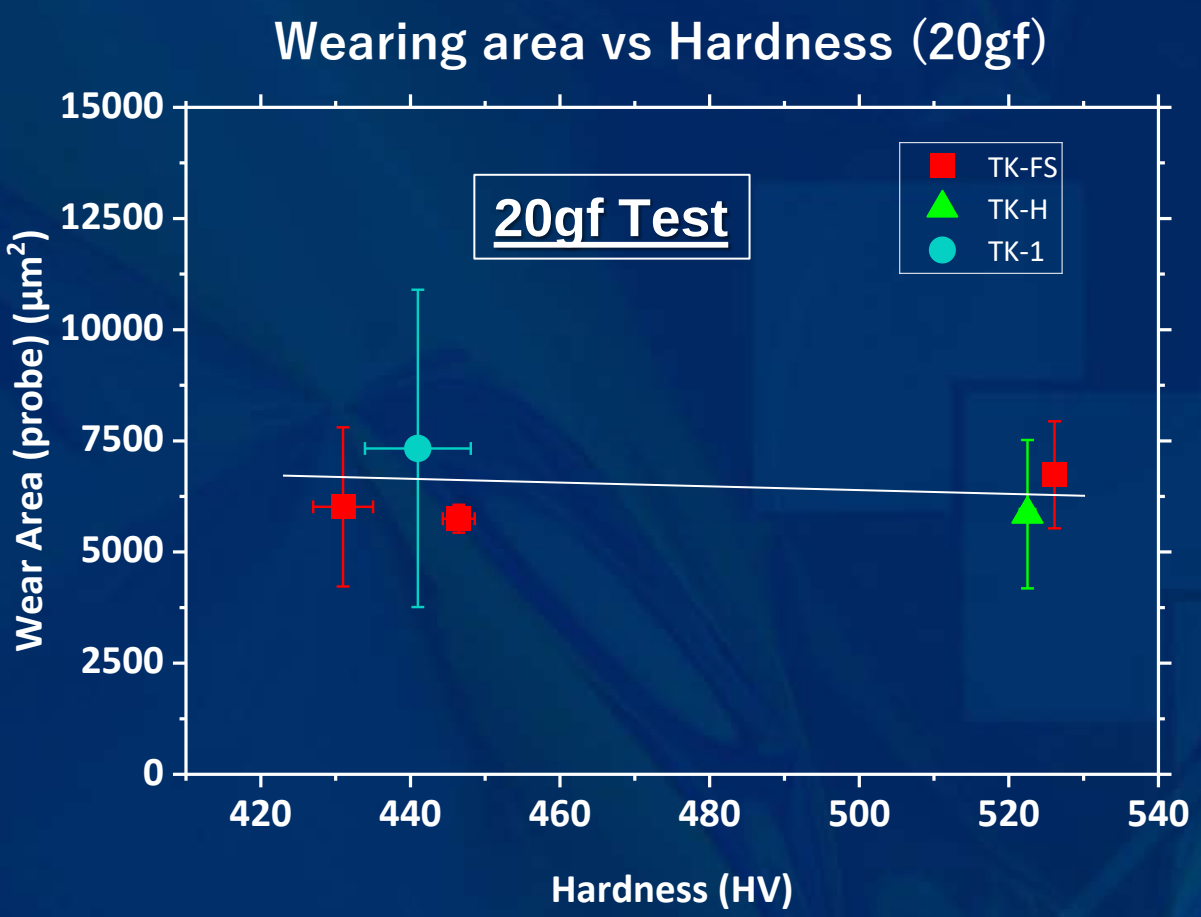


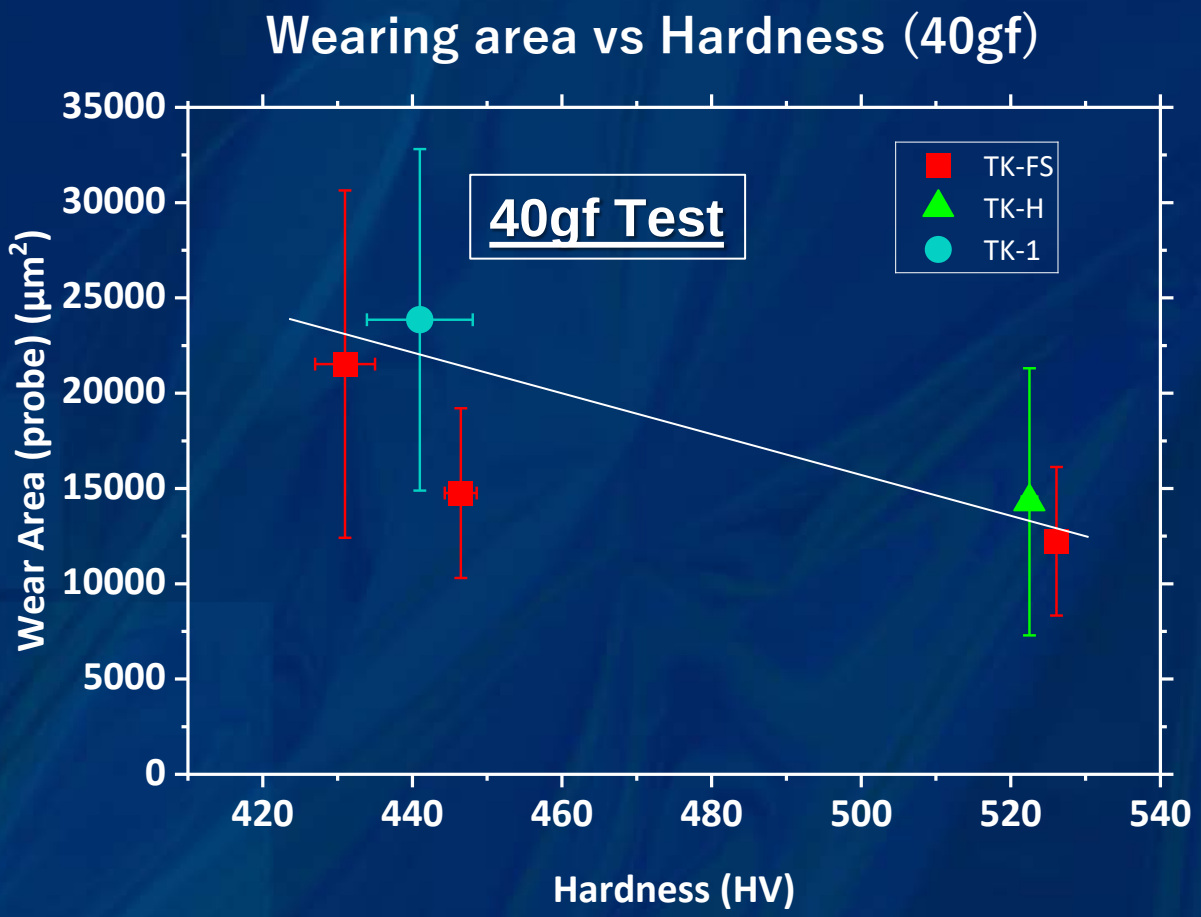


Surface of Probe tip and substrate (before / after test)

	Before	After					
		TK-FS (520HV)		TK-1 (440HV)		TK-H (520HV)	
		20gf	40gf	20gf	40gf	20gf	40gf
Tip							
Substrate							

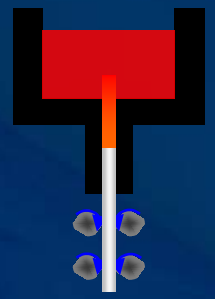
Wearing behavior of Pd-based materials



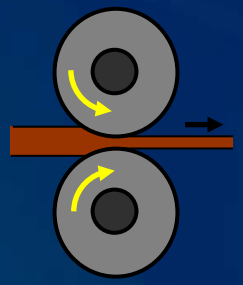


20gf test: Wear area shows almost same, **NOT affected by the hardness** of materials.
40gf test: Wearing area **decreases with increasing the hardness** of materials.

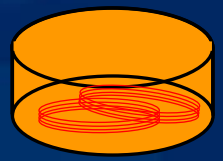
Manufacturing Process of Pd-based materials



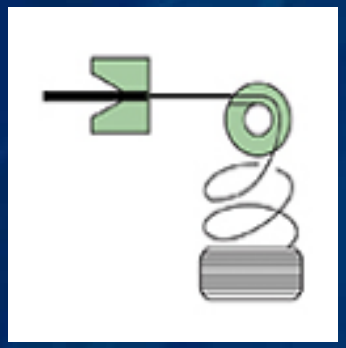
Continuous casting



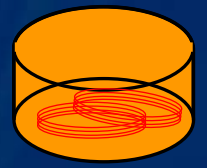
Groove rolling



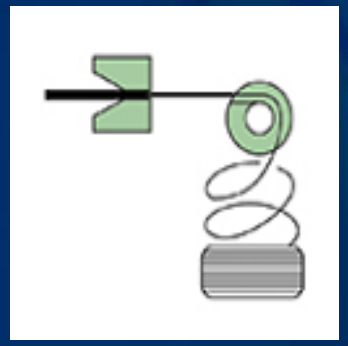
Heat treatment



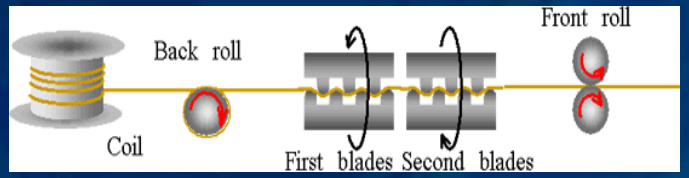
Drawing



Heat treatment



Drawing

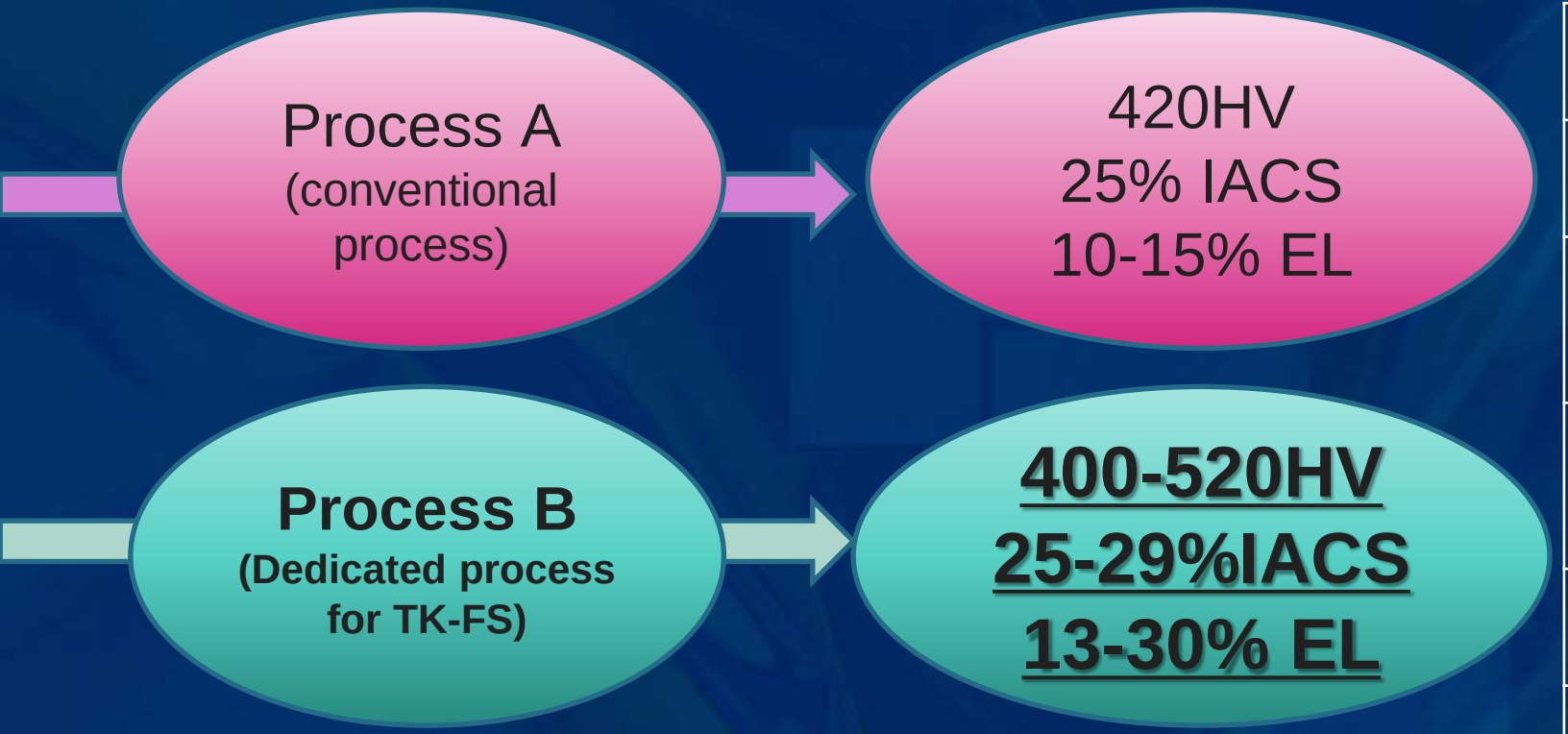


Straightening

Inspection

Shipping

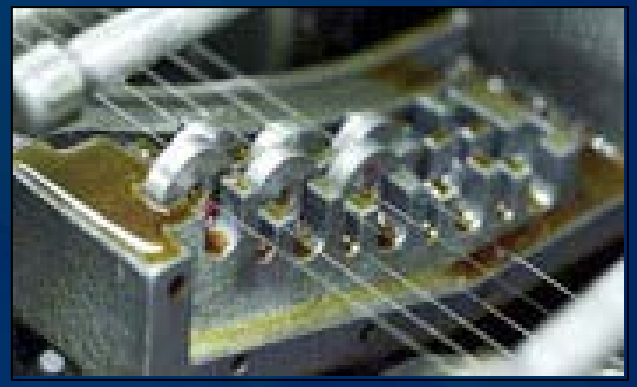
Manufacturing Process of TK-FS

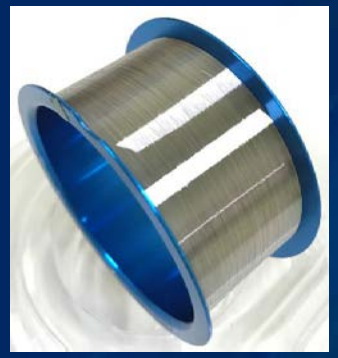


	Process A	**Process B**
Hardness (HV)	420	**400-520**
Young's modulus (GPa)	115	**150**
Electrical Conductivity (%IACS)	25	**25-29**
Elongation (%)	10-15	**13-30**
90° Bends	8-10	**8-14**

The TK-FS dedicated process (Our know-how) allows a wide range of adjustments in each characteristics, although only a limited range of properties could be achieved with the conventional process.

Capable wire diameter / Future business of “TK-FS”





We have already succeeded in manufacturing **0.03 to 1.0mm in diameter,** and are trying to manufacture less than 0.03mm products.

Foil type products (0.02~0.1mm in thickness) are also been trying to establish manufacturing process.

We plan to **replace various current Pd-based Probe-pins materials with TK-FS** in the future!

Conclusion

- Depending on the types of probe-pins using in the semiconductor manufacturing process, high hardness, high electrical conductivity and high ductility are required for Probe-pins materials.
- TK-FS can be applied to various types of Probe-pins. TK-FS is manufactured by the dedicated process and its characteristics are widely adjustable.
- In the wear test, the results are different in the test load. (At high load test, Wearing area decreases with increasing the hardness of materials.)
- We have already succeeded in manufacturing TK-FS fine wire with 0.03 to 1.0mm in diameter, and are trying to manufacture less than 0.03mm in diameter, and also foil products with 0.02~0.1mm in thickness.
- We plan to replace various current Pd-based Probe-pins materials with TK-FS in the future.

THANK YOU !

Let’s discuss in detail about “TK-FS” at Our Exhibition Booth (#500)!!

Web Site: https://tanaka-preciousmetals.com/en/products/detail/probe-pins/