

Introduction to conductive glass (NTA glass) and its application products

Art Beam Co. Ltd.

Conductive glass (NTA glass[®])

Nano Technology Assorted Glass

Japanese Patent No. 3854985 (applied for 2001, granted 2006)

“Vanadate glass and its manufacturing method”

Patent holder: Tetsuaki Nishida (Professor, Kinki University, Faculty of Humanity-Oriented Science and Engineering)

License granted (No. 8389, registered in the Patent Registry on January 15, 2007)

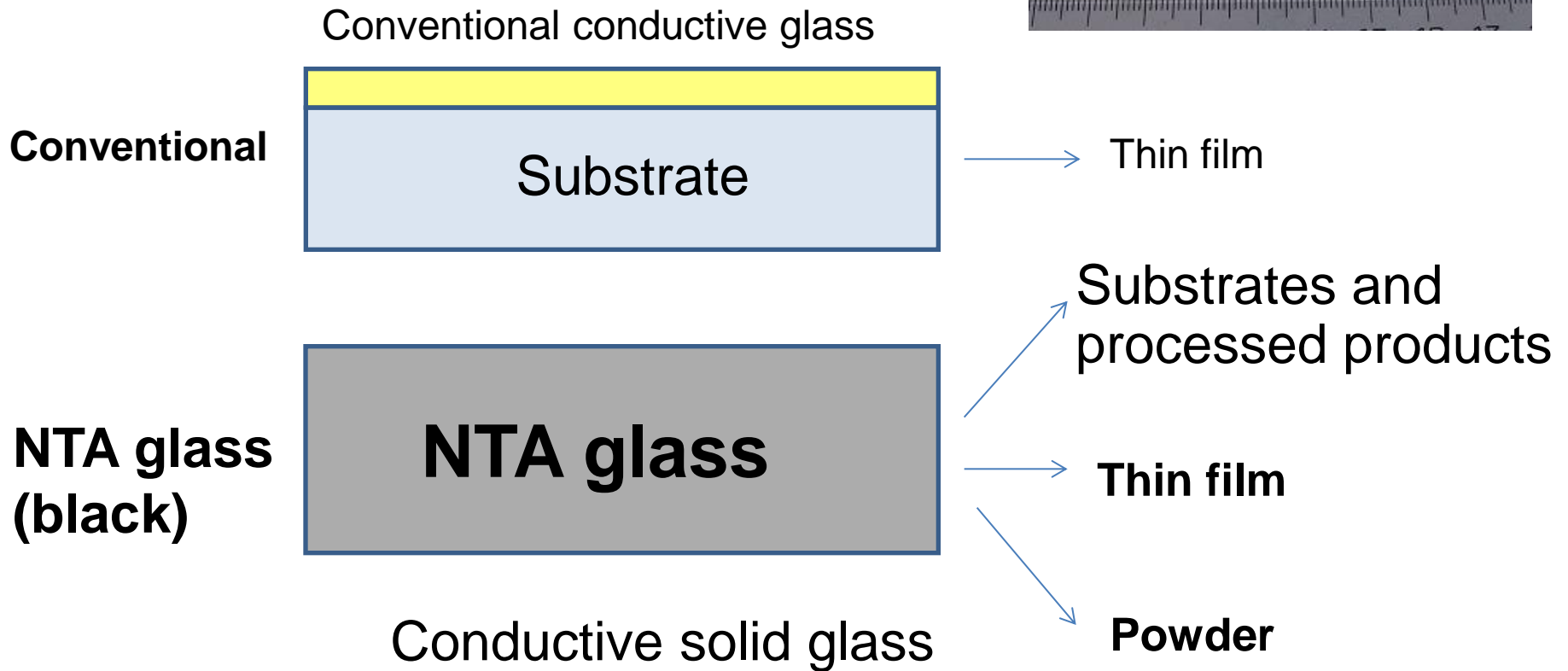
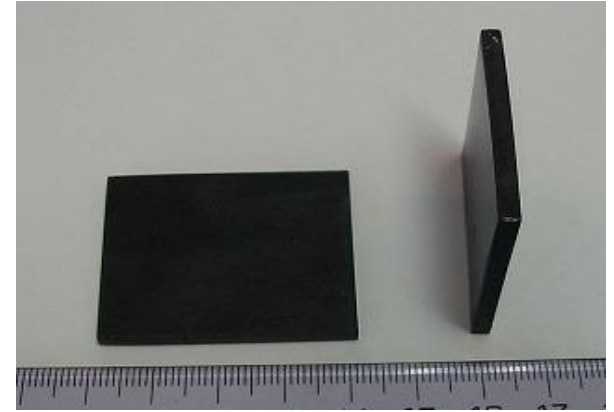
“NTA glass”—Registered trademark (registered in 2006 by Tokai Industry)
Registration number: 50099023

Kinki University
Nishida Laboratory



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Features of NTA glass



Major advantages

Low softening point

Lead- and bismuth-free

Conductive

NTA glass

Noncorrosive

Use for soldering

Processable by a variety of methods
From machining to Focused Ion Beam (FIB)

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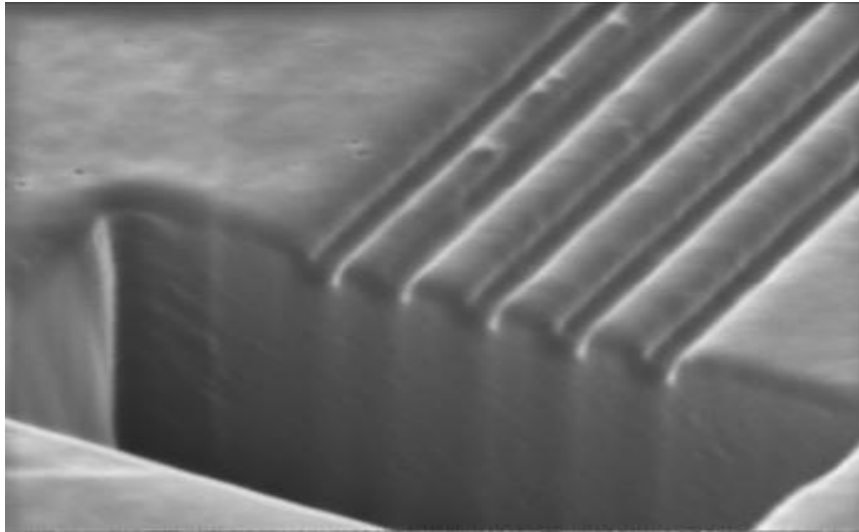
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Properties of NTA glass (standard) and comparison			References: Properties of glass (Source: "Rikagaku Jiten")
		Note	
Electrical resistivity	30 Ω cm or less	10 ⁻⁴ Ω cm or less depending on constituents and formula	
Glass transition point	400 °C		
Deformation point	460 °C		500 °C - 700 °C
Expansion coefficient	9.32 x 10 ⁻⁶ /K	20 °C - 300 °C	0.5 - 20 x 10 ⁻⁶ /K
Hardness	460 kg/mm ²	Approx. 5.5 (Mohs hardness)	5 - 7 (Mohs hardness)
Transmittance	0 %	200 nm - 2,400 nm	
Reflectivity	17-13 %	Compared to aluminum with reflectivity taken as 100% 350 nm - 750 nm	
	12 %	Compared to aluminum with reflectivity taken as 100% 750 nm - 2,600 nm	
Thermal conductivity	0.88 W/m·K	At 26 °C	
Thermal diffusivity	0.363 mm ² /s	At 26 °C	
Specific heat (heat capacity)	0.642 J/g·K	At 26 °C	
Density	3.78 g/cm ³	At 26 °C	2.2 - 6.3 g/cm ³
Young's modulus	81.6 - 85.0 Gps		5 - 9 Mps
Modulus of rigidity	32 Gpa		
Poisson's ratio	0.286		

Focused Ion Beam (FIB) micromachining

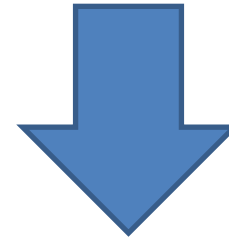


Cross-view image: Pattern of 100 nm width,
200 nm depth

Machining conditions:

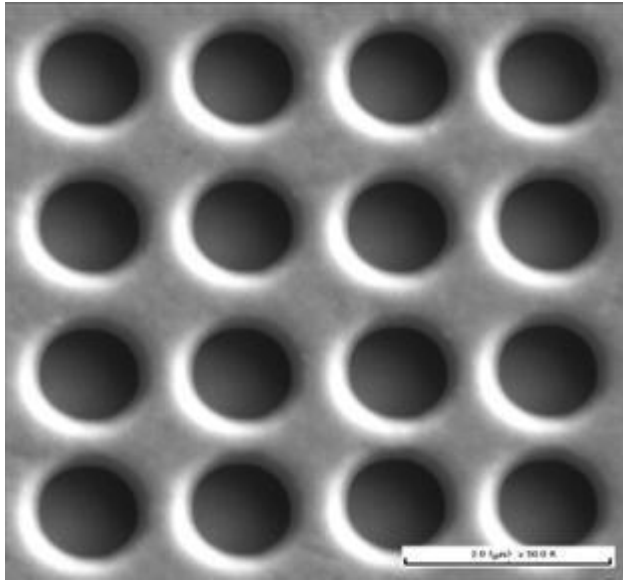
Accelerating voltage of 40 kV,
current of 11 pA/cm²

**Micromachining at the
order of 10 nm
Aspect ratio 1:10
High-speed machining
(at more than five times
the speed of aluminum
material)**

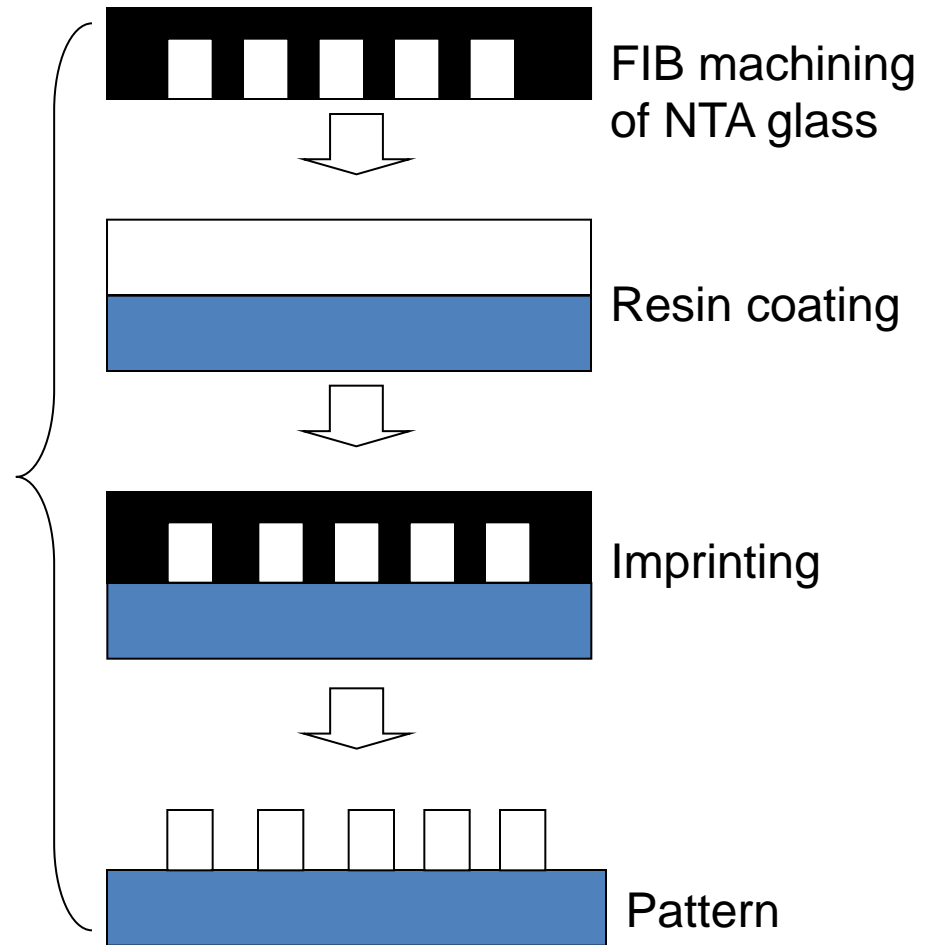


**Application in MEMS
and nano imprint fields**

Application to nano imprint



Main material for nano imprint technology



Glass powder

(1) Glass frit for metal paste

(2) NTA glass paste

(1) Glass frit for metal paste

– Low softening point, lead- and bismuth-free –



Glass composition	Composite oxide of V, Ba and Fe
Properties	Black powder
Mean particle diameter	2.5-3.0 (μm)
Linear expansion coefficient	85-105 ($\times 10^{-7}/^{\circ}\text{C}$)
Uses	Electrodes, sintering aids for electrodes, conductive bonds, antistatic agents, etc.

(2) NTA glass paste (Pro Glass VP)



Properties	Blackish brown paste
Viscosity	30 - 80 (Pa·s)
Application method	Screen printing
Recommended drying temperature	130 °C -150 °C for 10 to 20 minutes
Recommended standard operating temperature	Temperature rise/fall: 20 °C - 40 °C per minute Peak temperature: Maintained at 460 °C - 510 °C for 5 to 10 minutes

Applications of NTA glass paste Encapsulant and sealant for LSI, etc.



Conductive and noncorrosive

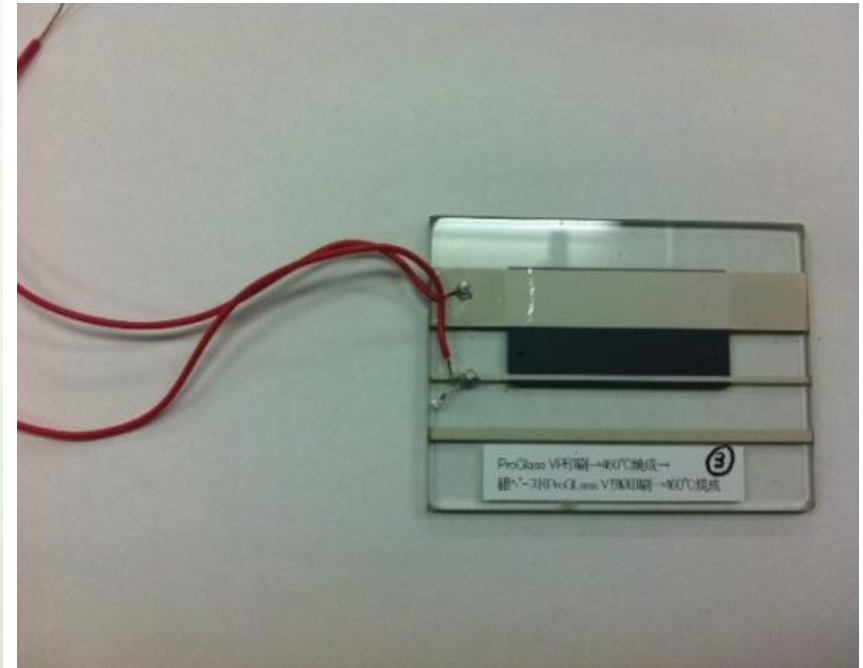
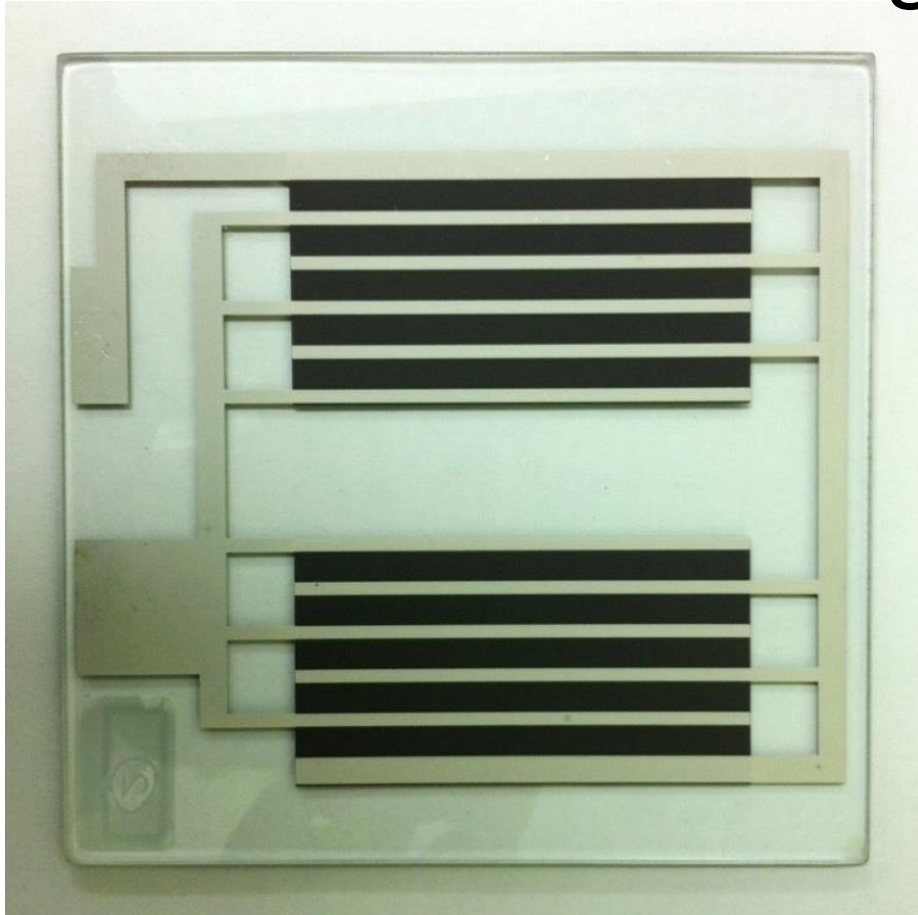


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Application of NTA glass paste: Heat glass



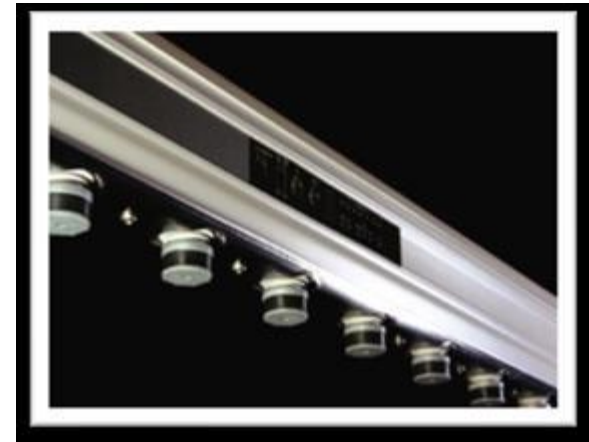
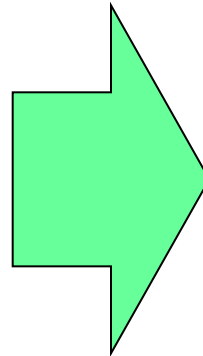
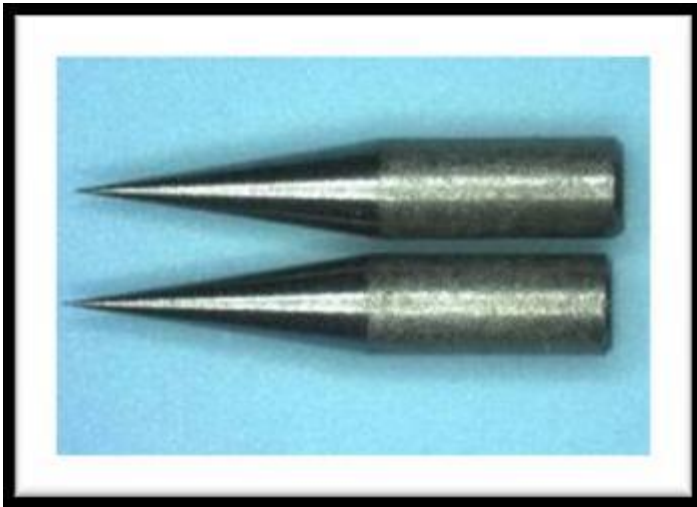
Conductive, noncorrosive, used for soldering

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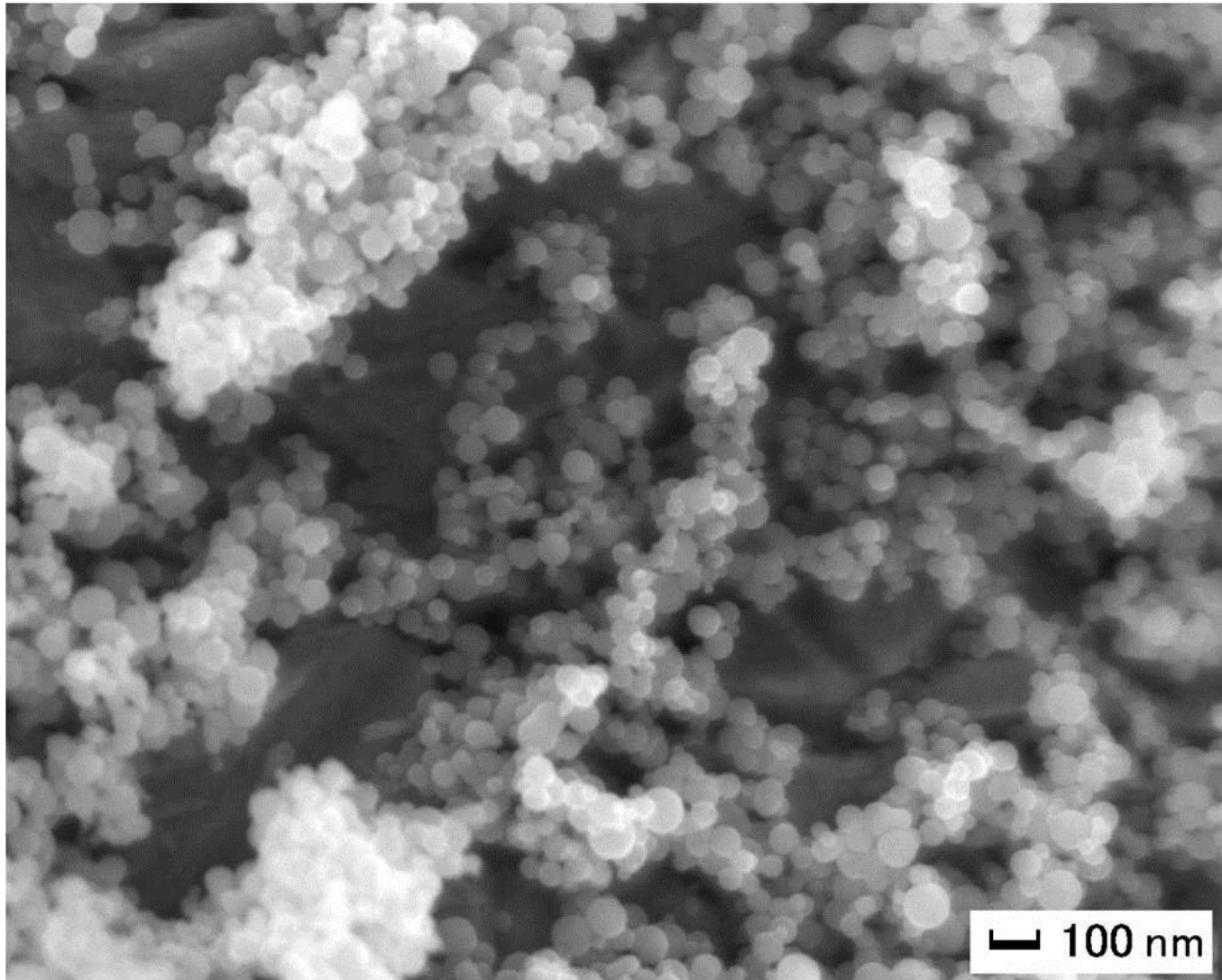
Other applications

Example of machining products:
Ionizer discharge nozzle



-  **Conductive**
-  **Noncorrosive
(no dust produced)**

NTA glass nanoparticles (spherical, 100 nm or less)



Nanoparticles formed by use of
radio-frequency thermal plasma.


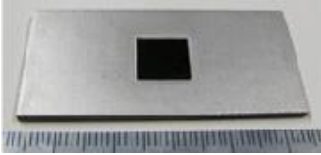
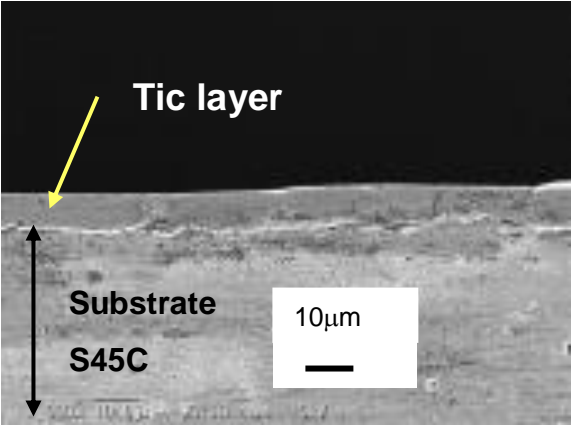
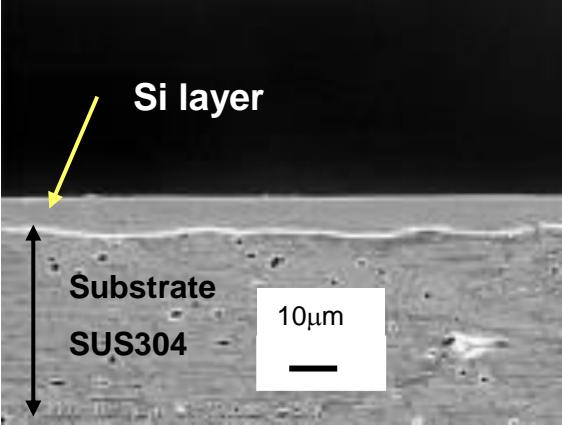
Offering dispersion samples tailored to customer's needs



NTA nanoparticle dispersion (1)
(DAA)
(solid content 10%)
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NTA nanoparticle dispersion (2)
(DAA)
(solid content 10%)
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Types and applications of MScoating films

	Ti (titanium) coating	Si (silicon) coating
Aims	Anti-abrasion	Anti-corrosion, anti-erosion
Appearance		
Cross-sectional image		
Applications	Molds, jigs, turret punch press and chucks	Anti-corrosion/Anti-erosion parts
Metal coating	<ul style="list-style-type: none"> * Thickness: 5-15 μm * Hardness: 1,200-2,500 HV * Surface roughness: 6-20 μmRz 	<ul style="list-style-type: none"> * Thickness: 5-10 μm * Hardness: 1,000 HV * Surface roughness: 1-4 μmRz

Chromium-free chemical conversion coating “AT-21”

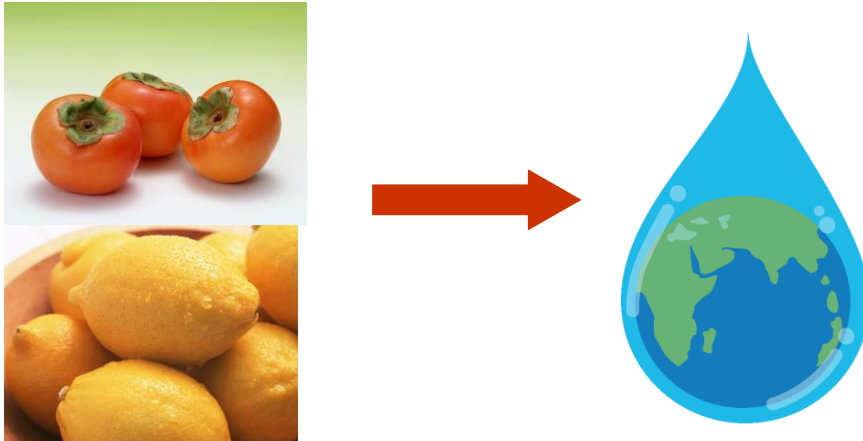
Chromium-free chemical conversion coating “AT-21” is an environmentally-friendly coating liquid that forms an anti-corrosive film on zinc and zinc alloy plates without the use of chromium compounds.

Advantages of AT-21 coating

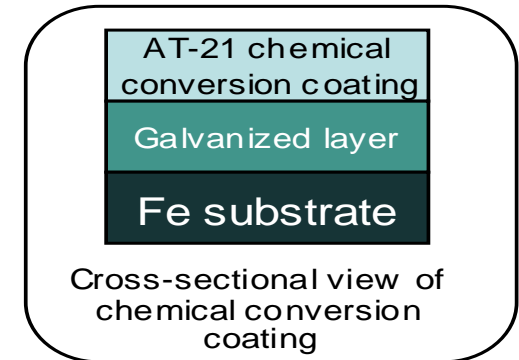
- Environmentally-friendly ⇒ Chromium-free coating
- Anti-corrosive ⇒ Equal to trivalent chromium coating
- Cost ⇒ More cost-effective than trivalent chromium coating

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Major constituents of AT-21



The major constituents of AT-21 are tannin and citric acid. Tannin is made from persimmon juice, and has anti-corrosion and antiseptic effects. This makes AT-21 an environmentally-friendly coating.



We look forward to doing business
with you.

Art Beam Co. Ltd.
Joint development with
Tokai Industry Co. Ltd.