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Tennant20: Osmium Coating System

Product Brochure | August 2026 Edition

Discovery awaits
beneath an ultra-thin veil

Meiwafosis

Superior Observation Begins with Sample Preparation

The Trusted Choice of Researchers Worldwide

The quality of electron microscopy imaging and analysis depends heavily on sample preparation. The Tennant20 is a high-precision system designed to dramatically enhance structural reproducibility and analytical accuracy through advanced osmium coating technology.

Excellence in Function, Experience, and Safety

------ Why We Are the Trusted Choice

Since the launch of our proprietary multi-purpose coater in 1997 —integrating sputter coating, plasma CVD, and hydrophilization— Meiwafosis has spent over two decades refining its technology. This continuous evolution led to the Neoc series, an osmium coater featuring specialized electrodes that significantly expand the negative glow region. Going beyond conventional sputter coating, the Neoc extends its capabilities from SEM observation to elemental analysis and a wide range of other applications, earning the trust of users across diverse fields.

Our legacy osmium coater has now been reborn as the Tennant20, designed to set a new global standard in electron microscopy sample preparation.

While osmium tetroxide is highly toxic, the Tennant20 incorporates rigorous safety measures to ensure a secure operating environment. Its uncompromising safety, combined with superior coating performance, has made it the preferred choice of many researchers throughout Japan.

Since its launch in 2021, more than 50 units have been delivered across Japan. In late 2024, we expanded into the European market, and our systems are now used by researchers worldwide.

Developed in collaboration with the Tokyo Metropolitan Industrial Technology Research Institute, Product Development Support Lab.

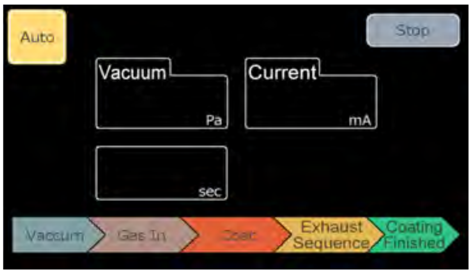
Operability & Interface

Intuitive Touchscreen

The Tennant20 features an intuitive touchscreen interface that allows even first-time users to operate the system with ease.

It offers an intuitive touchscreen interface that guides users through each step, starting with six simple options on the home screen.

Auto Mode

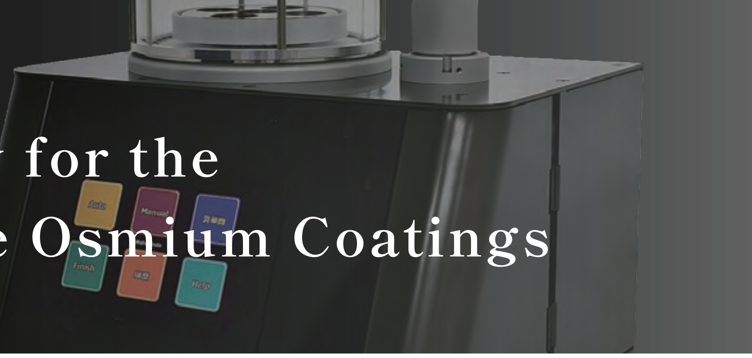


The system automatically manages the entire workflow simply by entering the target film thickness including vacuuming, coating, and the final exhaust sequence.

Power Control Mechanism for Enhanced Reproducibility

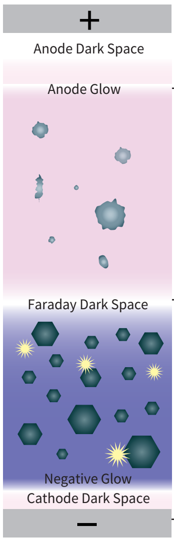
The Tennant20 utilizes high-speed feedback control to maintain the coating current at the set value, correcting fluctuations in 1/1,000-second increments. This precision power control, driven by a proprietary algorithm, suppresses inrush current and ensures consistent deposition results every time.

This enables users to easily achieve highly reproducible coatings while ensuring reliable processing with minimal inter-sample variability.



Plasma CVD Technology for the Formation of Conductive Osmium Coatings

The plasma CVD method introduces sublimated osmium tetroxide gas into a vacuum chamber, where it is converted into plasma via a DC glow discharge. During this process, the chamber environment is divided into two distinct regions: the "positive column region" and the "negative glow region."



Plasma State in Glow Discharge

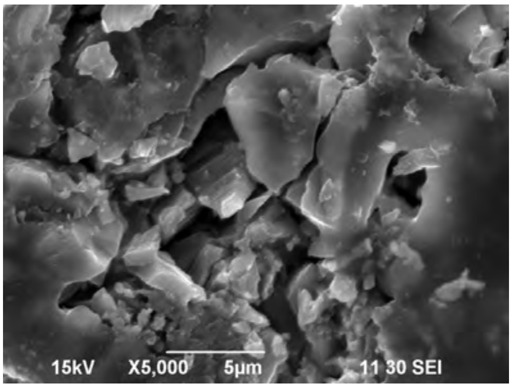
Positive Column Region (Osmium Oxide Coating)

In this region, the coating process occurs in a mixture of residual gases and unstable osmium ions, resulting in the formation of an osmium oxide film that is susceptible to electron beam damage and easily degraded.

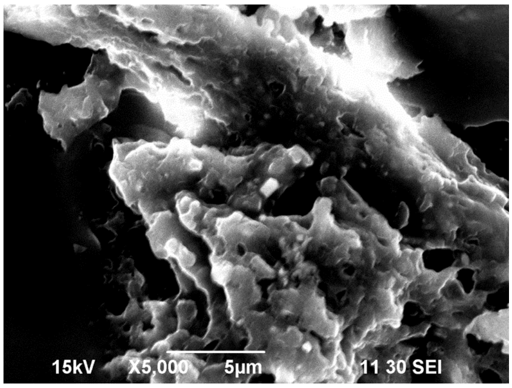
Negative Glow Region (Osmium Coating)

By plasmaizing sublimed OsO_4, it dissociates into osmium ions and oxygen ions. In the negative glow region above the cathode, the generated osmium ions deposit onto the substrate surface, forming a robust metallic osmium film. This results in a highly conductive coating that withstands electron beam damage, even at an ultra-thin thickness.

SiC Wheel



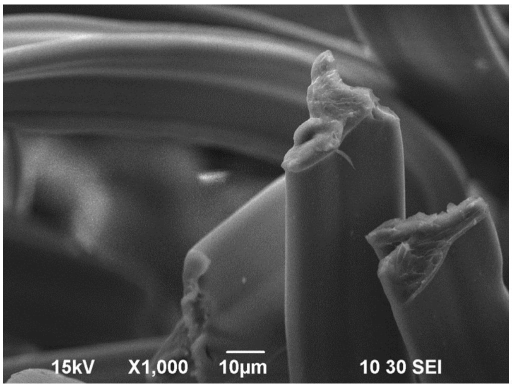
Negative Glow Region, 5,000x



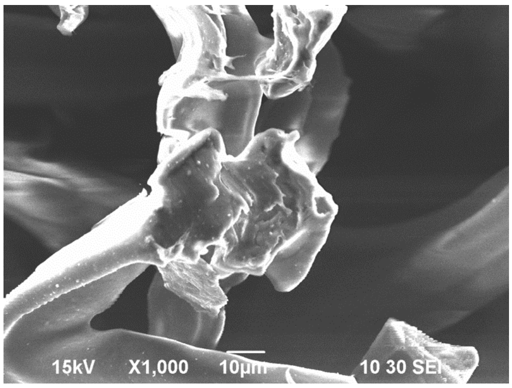
Positive Column Region, 5,000x

Coating in the negative glow region enables detailed observation without charging. In contrast, coating in the positive column region produces an osmium oxide (OsO_4) film that is susceptible to electron beam damage, leading to visible charging effects.

Acetate Fiber



Negative Glow Region, 1,000x



Positive Column Region, 1,000x

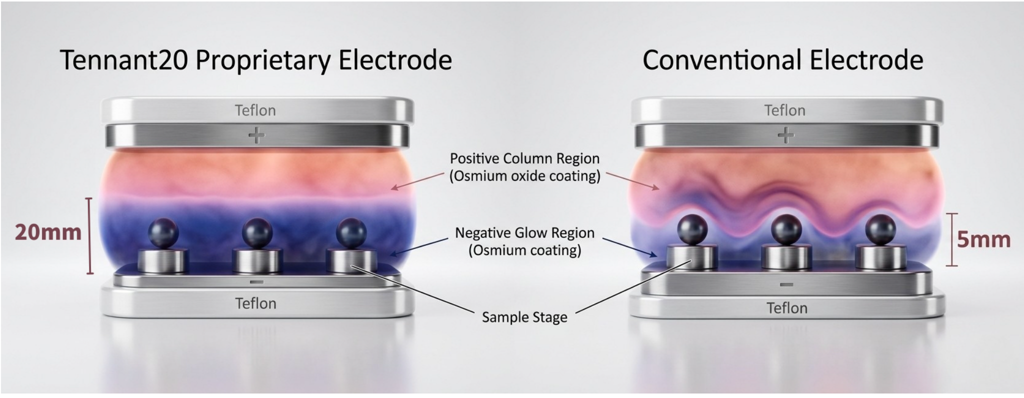
Osmium coating in the negative glow region produces clear images, even for samples such as filters that are prone to drift and charging.

Operability & Interface

Expanded "Negative Glow Region" for the Formation of Conductive Osmium Coatings

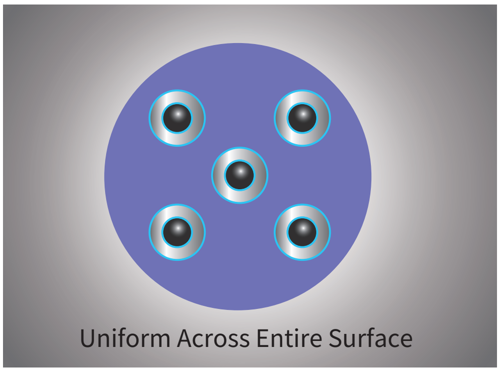
Comparison of Negative Glow Region Heights

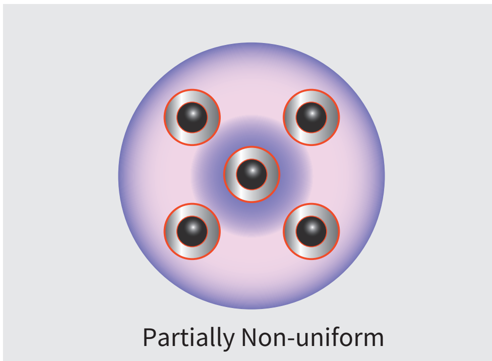
Standard parallel-plate electrodes have a shallow negative glow region height of only 5 mm. For samples exceeding this height, an osmium oxide film inevitably forms within the positive column region. In contrast, the Tennant20 has significantly expanded the negative glow region height to over 20 mm.



Top View: Comparison of Negative Glow Regions

With conventional parallel-plate electrodes, film thickness tends to be uneven, thicker at the center and edges while thinner in a ring-shaped area in between. In contrast, the Tennant20 features electrodes encased in insulating Teflon, which prevents discharge from concentrating at the edges and enables the formation of a uniform negative glow region across nearly the entire sample stage.

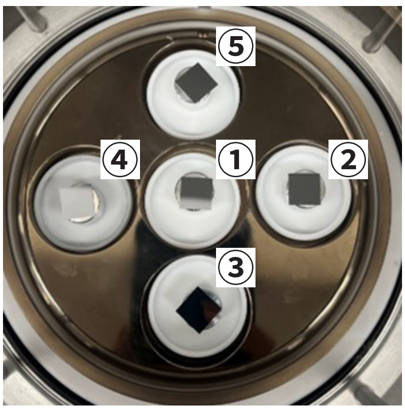




…Negative Glow Region (Osmium Coating)

…Positive Column Region (Osmium Oxide Coating)

Achieve Uniform Film Thickness Regardless of Sample Positioning



Position	Film Thickness [nm]
1	5.047
2	4.768
3	4.354
4	4.975
5	5.313

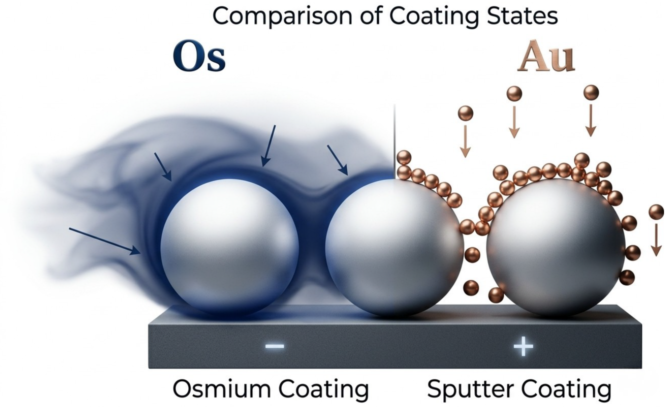
* Measured using the FS-RT300 Multi-Wavelength Ellipsometer

Formation of Ultra-Thin Films Without Charging

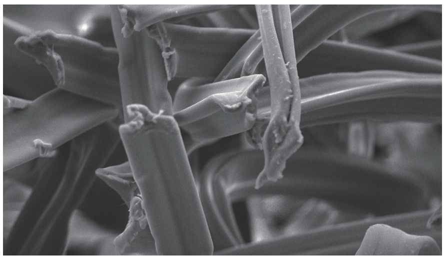
Osmium is a platinum group metal with an atomic number of 76. With its high density, hardness, and chemical stability, it offers ideal properties as a conductive material for SEM observation.

Comparison of Coating States

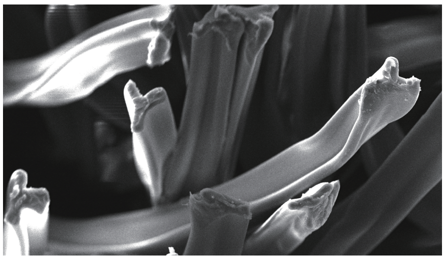
Osmium coating via plasma CVD ensures conductivity even in ultra-thin layers, effectively suppressing charging effects that can compromise SEM observations. It provides a uniform coating that reaches every intricate detail of the sample. Unlike gold sputter coatings, which are prone to granulation, osmium remains smooth and is ideal for high-magnification imaging. Additionally, minimal thermal damage helps preserve the sample's integrity.



Acetate Fiber



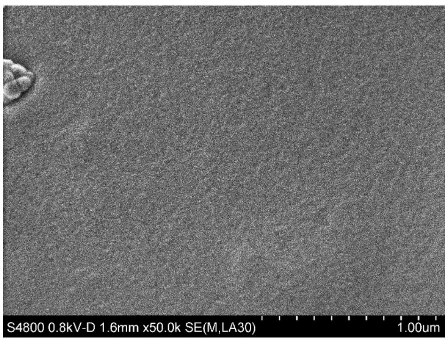
Osmium Coating, 500x



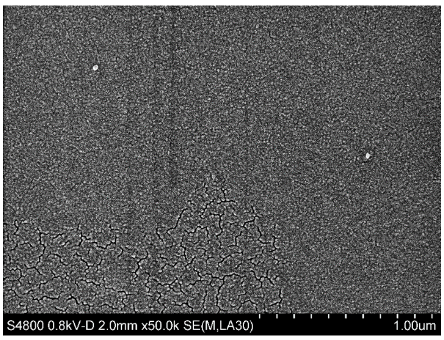
Gold Sputter Coating, 500x

Gold sputter coating often fails to reach the deep recesses of complex structures, resulting in visible charging and a metallic texture that obscures the sample's true surface.
In contrast, osmium coating allows for high-quality observation without compromising the natural surface texture; the superior quality of the surface layer is evident even at low magnifications.

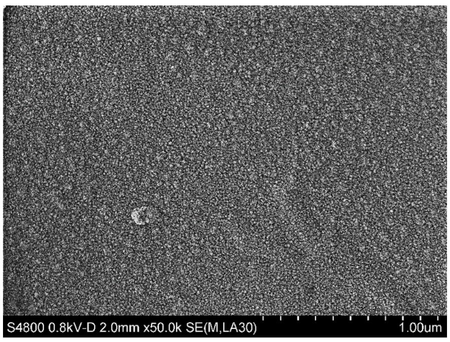
SiC Wheel



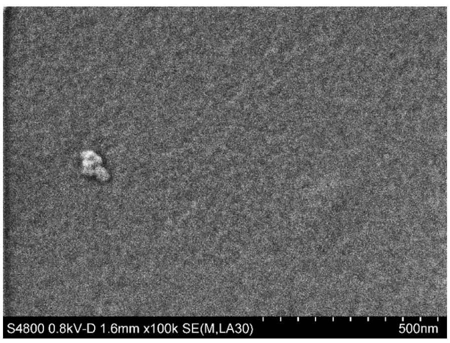
Osmium Coating, 50,000x



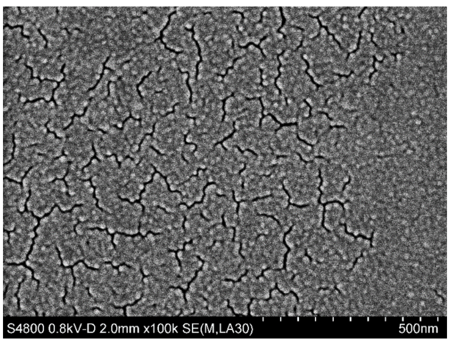
Gold Sputter Coating, 50,000x



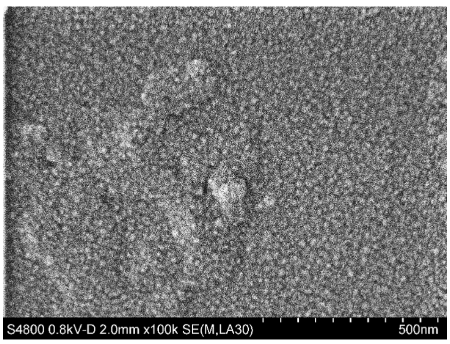
Platinum Sputter Coating, 50,000x



Osmium Coating, 100,000x



Gold Sputter Coating, 100,000x



Platinum Sputter Coating, 100,000x

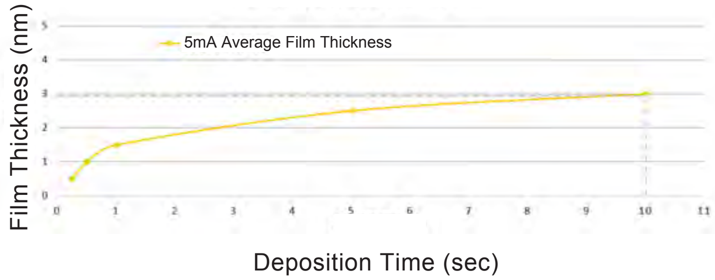
Ideal Sample Preparation for SEM, EDX, AES, XPS, and EBSD

Simple Operation for Highly Reproducible Film Thickness Control

Precision timer control (1/100 second) enables the deposition of a wide range of coatings, from ultra-thin films under 1 nm to thicker layers. Because the thickness of the conductive osmium film is proportional to the discharge time, nano-level thickness control can be easily achieved.

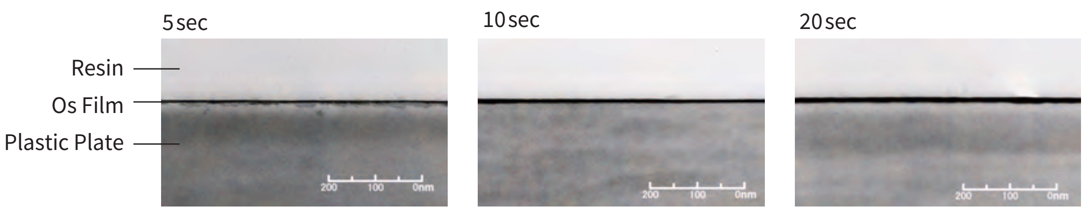
The ability to reproducibly deposit ultra-thin films under 1 nm has made this system a proven choice not only for SEM sample preparation but also for antistatic coatings in the elemental analysis of insulators and in ultra-surface

Deposition Time vs. Film Thickness



* Measured using the FS-1 Multi-Wavelength Ellipsometer

Thickness Measurement via TEM after Coating on Plastic Fragments

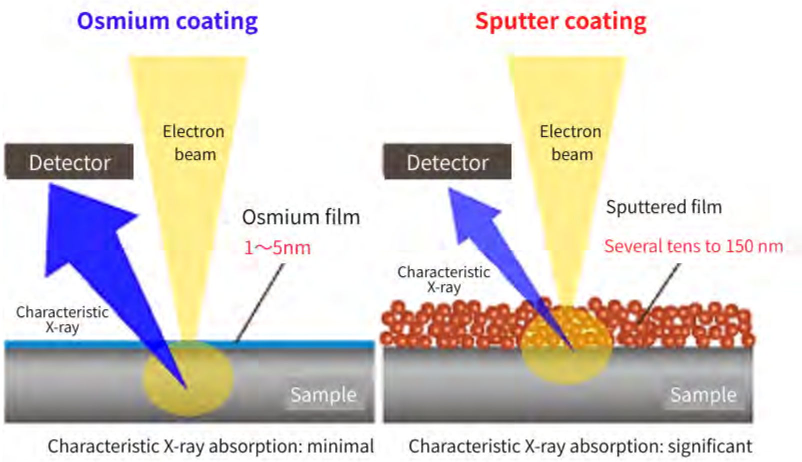


Data provided by JEOL Ltd.

Enabling Quantitative EDS Analysis of Light Elements such as Carbon and Nitrogen

Conventionally, an antistatic coating of several tens of nanometers was required to cover the entire sample surface for EDS (Energy Dispersive X-ray Spectroscopy). However, quantitative analysis was difficult without complex corrections, as characteristic X-rays were absorbed by the thick antistatic layer.

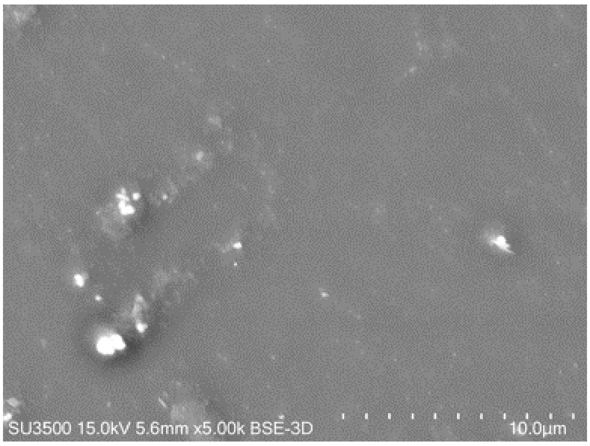
With the Tennant20, a uniform osmium film can be formed across the entire sample surface at a thickness of only a few nanometers. Because absorption of characteristic X-rays is extremely low, quantitative analysis can be performed without compromising accuracy. This is particularly well suited for the quantitative EDS analysis of light elements such as carbon and nitrogen.



Reference: "EDS quantification of light elements using osmium surface coating"
Journal of Mineralogical and Petrological Sciences,
Volume 110, page 189-195,2015
Ehime University, Geodynamics Research Center
Professor Hiroaki OHFUJI, Mr. Masashi YAMAMOTO

Energy-Dispersive X-ray Spectroscopy (EDS) Analysis

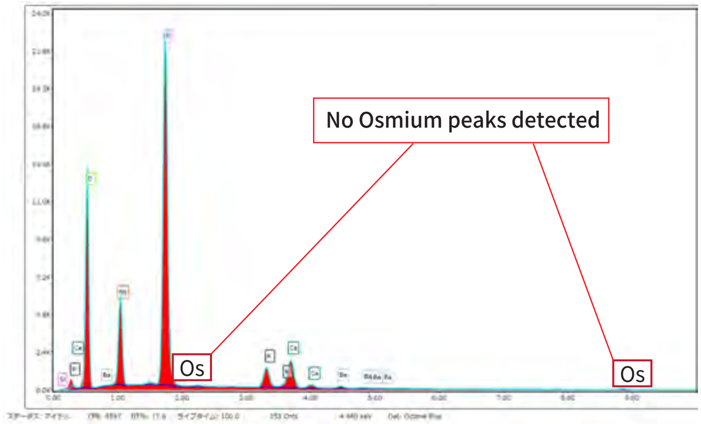
EDS analysis was performed on an Os film (thinner than 1 nm) coated onto a glass slide using the osmium coater. While Au and Pt elements are typically detected with gold and platinum sputter coatings, the Os element remains undetected due to the system's ability to form ultra-thin films under 1 nm. As shown in the graph, this ensures that high-quality data can be acquired without interfering with EDS analysis.



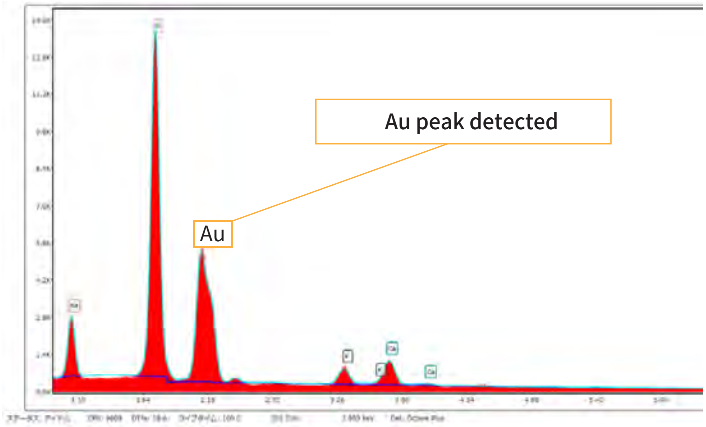
5,000x

Instrument: SU3500 Scanning Electron Microscope (Hitachi High-Tech)
Measurement Range: Si, K, Ca, O, Ba, Na, Zn, Au, Pt
Deposition System: Neoc-Pro Neo Osmium Coater (Meiwafosis)

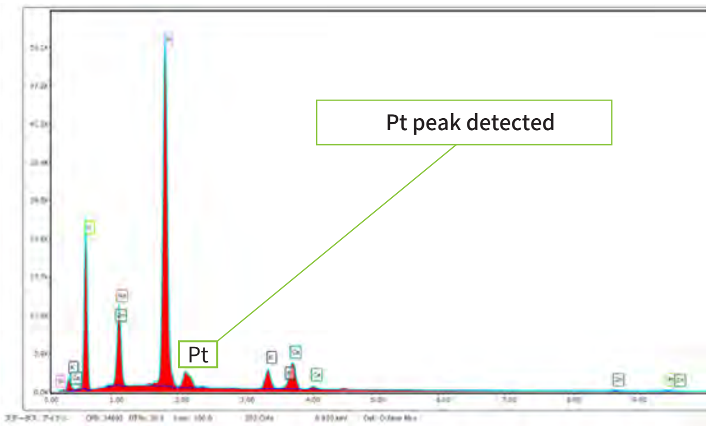
Os Film



Au Film



Pt Film



Features & Applications

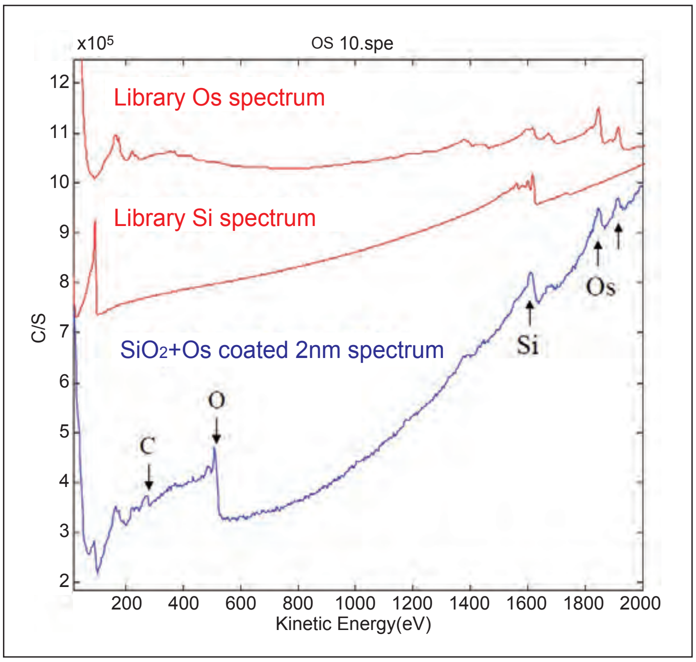
Antistatic Coating Applications

Antistatic Coating for Auger Electron Spectroscopy

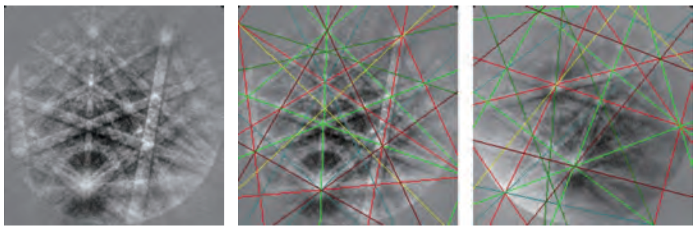
Auger Electron Spectroscopy (AES) analyzes the topmost surface layer (extremely shallow regions up to approximately 5 nm from the surface). Therefore, osmium coater technology —which allows nanometer-level control of film thickness— is highly effective.

The figure on the right shows an analysis of a SiO_2 sample coated with a 2 nm osmium layer to prevent charging. As shown, Auger electrons from the Si substrate are clearly detected without interference from the antistatic film. This enables elemental analysis of insulating materials without charging effects.

Data provided by YAZAKI Corporation



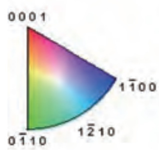
Antistatic Coating for EBSD



Alumina (Approx. 50 x 70 x 4 mm t)

Testimonial

"For EBSD analysis of non-conductive materials, there is strong demand for surface coatings that maintain electrical conductivity without obstructing backscattered electrons emitted from crystals near the surface. Additionally, the coating must remain stable under electron beam irradiation.
With the Neoc Osmium Coater, we were able to easily deposit a thin yet robust conductive film, resulting in exceptionally clear Kikuchi patterns. Furthermore, the coating reaches even the smallest pores and deepest recesses, allowing observation of samples with complex surfaces without any charging issues."



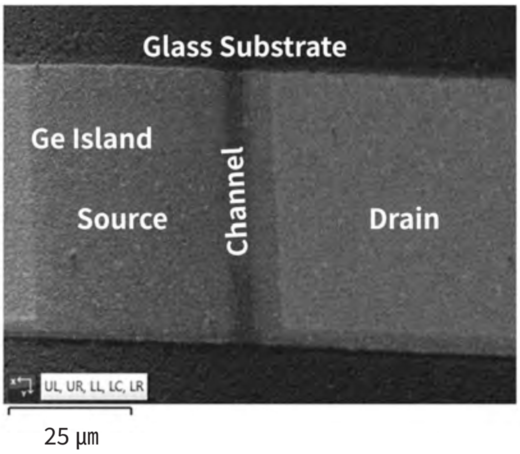
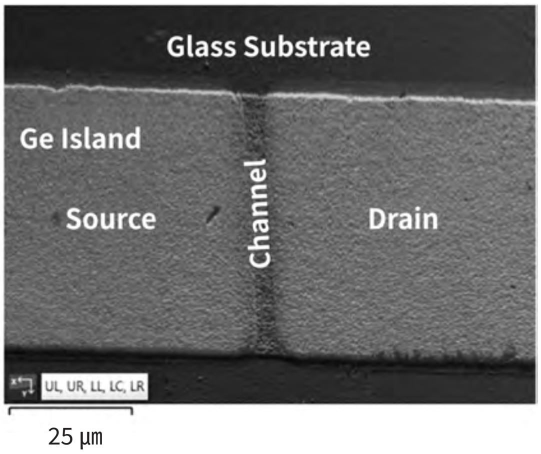
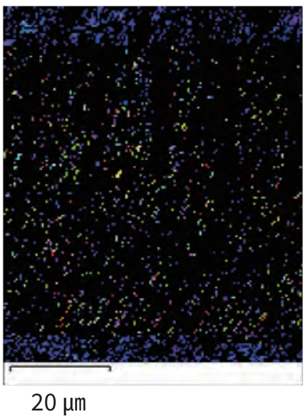
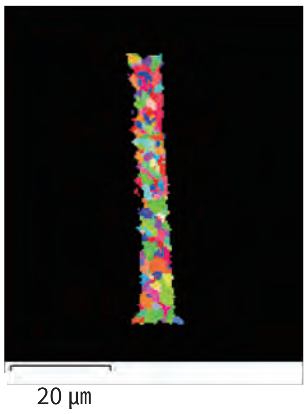
Inverse Pole Figure Map

Image Quality Map

Achieving Clear EBSD Images

EBSD Analysis of Polycrystalline Ge

In this example, a polycrystalline germanium (Ge) thin film was formed on a glass substrate to fabricate a thin-film transistor, followed by osmium coating. During EBSD acquisition of the channel region, charging normally makes it impossible to obtain an image without a coating. However, by applying a thin osmium film, a clear EBSD image was successfully obtained.

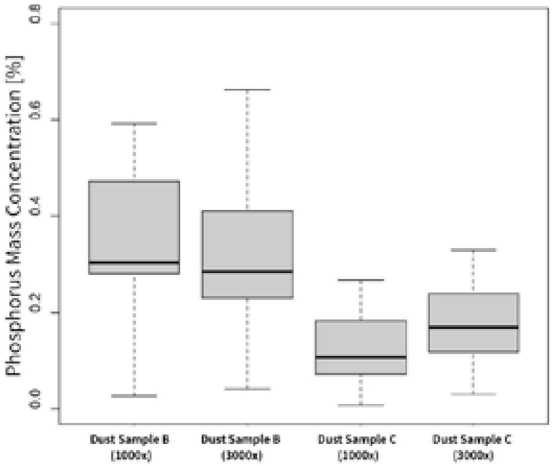
	Before Osmium Coating	After Osmium Coating
SEM Image		
EBSD Image		 

Data provided by Professor Kaoru Toko, Environmentally Friendly Materials in the Next Generations, Faculty of Pure and Applied Sciences, University of Tsukuba

Sample Preparation for FE-EPMA (Analysis and Observation of In-Vehicle Dust)

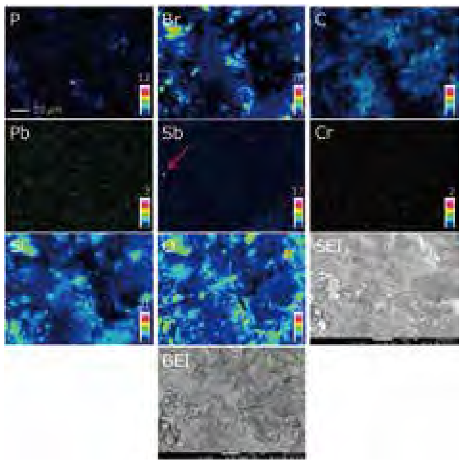
Phosphorus Quantitative Analysis Results via FE-EPMA

Quantitative analysis of phosphorus has been successfully performed.



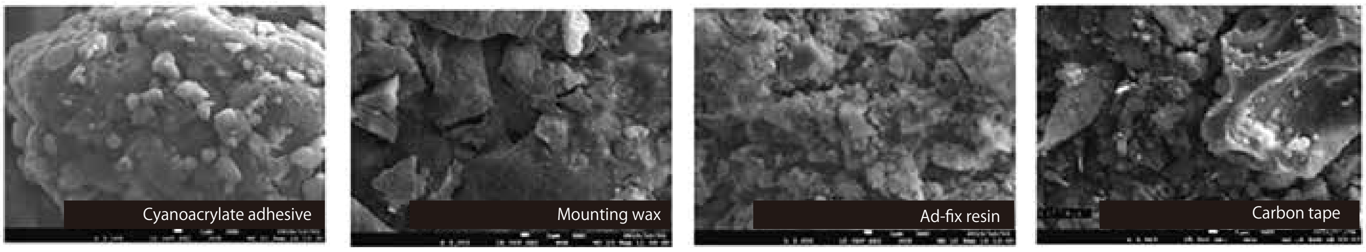
Color Mapping of SEI and BEI

Multi-element analysis is possible, demonstrating the effectiveness of osmium coating for sample preparation in FE-EPMA.



Deposition Conditions: Dust fixed onto the sample stage using carbon tape, etc.
Vacuum Level: 0.5 – 1 Pa
Deposition Time: 20 – 25 sec
Current: Approx. 10 mA
Film Thickness: Approx. 10 – 12.5 nm

Comparison of Secondary Electron Images Across Different Mounting Methods



Excellent observation results are obtained even with samples featuring irregular (rough) surfaces.

3,000x

Testimonial

"Exposure to pollutants via in-vehicle dust is a growing concern. Since these pollutants include both organic and inorganic substances, their measurement typically requires tedious sample preparation tailored to each material, as well as the use of different analytical instruments. To better understand the nature of dust contamination, there is strong demand for more streamlined measurement methods.

To develop such a method, our laboratory conducted elemental analysis of key pollutant indicators in in-vehicle dust using a Field Emission Electron Probe Microanalyzer (FE-EPMA). The Neoc-STB Osmium Coater was used for sample preparation in this study.

FE-EPMA is an analytical system capable of elemental and quantitative analysis by detecting characteristic X-rays emitted when an electron beam irradiates the sample surface. It is highly effective for microscopic targets such as dust, as it can simultaneously detect organic and inorganic pollutants and perform localized area analysis."

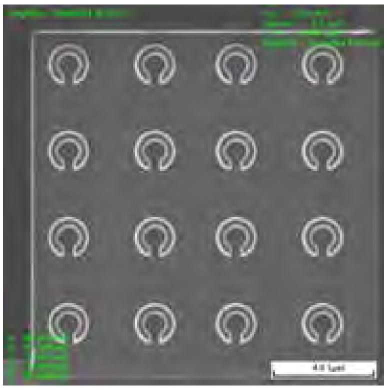
Data provided by Professor Shigeki Masunaga, Graduate School of Environment and Information Sciences, Yokohama National University

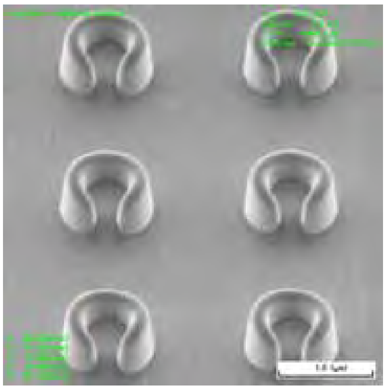
FIB Processing

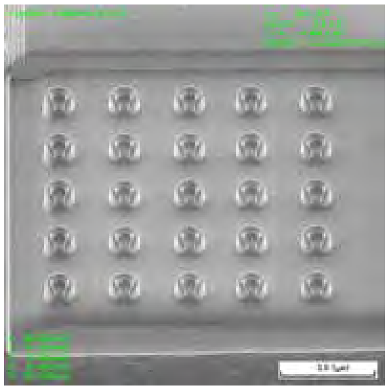
An osmium metal film is used as a protective layer during sample preparation prior to FIB processing. Even in thin films, osmium exhibits high electrical conductivity and excellent thermal dissipation, acting as an effective protective layer that shields the sample surface from FIB-induced damage. Furthermore, because the osmium film can be easily removed using hypochlorous acid, the coating can be stripped after FIB processing or analysis, allowing the sample to be reused for other analytical methods.

Fabrication Example: SIM Image of Molds for Metamaterials

Material: Single-crystal diamond. The area surrounding the C-shaped patterns has been entirely milled using FIB.



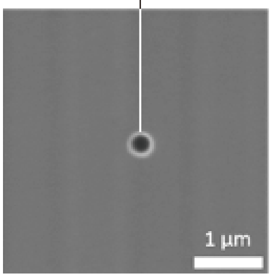




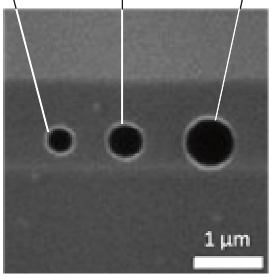
Data provided by Professor Masahiko Yoshino, Department of Mechanical Engineering, School of Engineering, Tokyo Institute of Technology (now Institute of Science Tokyo)

SIM Images of Nanopores Drilled in 4 μm-Thick Glass using FIB

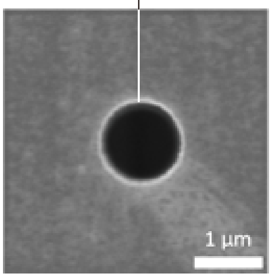
ϕ180nm

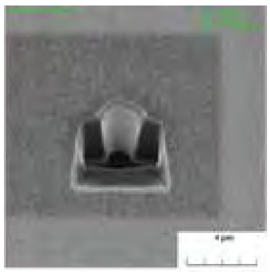


ϕ380nm ϕ510nm ϕ770nm



ϕ1000nm

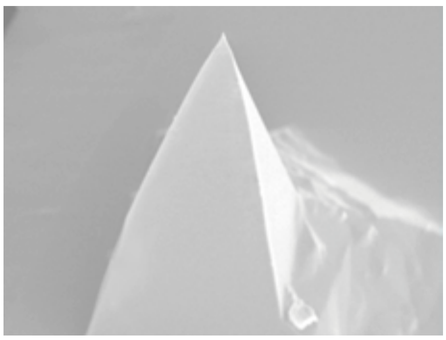




Scanning Ion Microscopy Image of Cross Section

Data provided by Associate Professor Takatoki Yamamoto, Department of Mechanical Engineering, School of Engineering, Tokyo Institute of Technology (now Institute of Science Tokyo)

Enhanced Durability for AFM Cantilever Tips



Calculations show that extremely high electric fields are applied to the tips of SPM and AFM cantilevers.

Because of this, cantilevers with coatings such as gold often suffer significant damage to the tip after only a few measurements, rendering them unusable. In contrast, cantilevers coated with osmium exhibit significantly higher durability, allowing these expensive components to be reused effectively.

Data provided by Dr. Toru Nakamura, National Institute of Advanced Industrial Science and Technology (AIST)

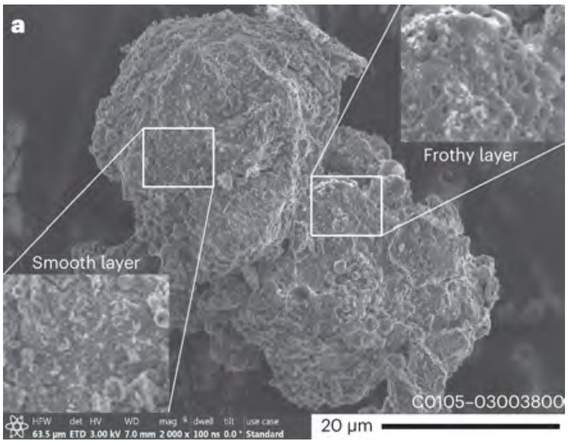
Features & Applications

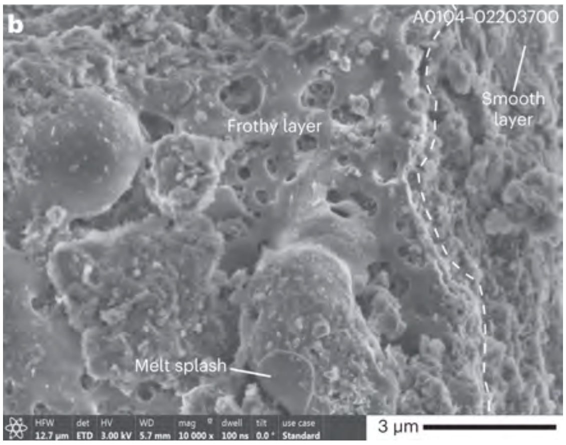
Contributing to Cutting-Edge Research — Applications in Published Papers

Minimize Thermal Damage with Excellent Coating

Surface Analysis of Ryugu Asteroid Particles

Utilizing Osmium Coating to Identify Ultra-Fine Space Weathering Layers





Secondary Electron Images of Space-Weathered Surface Modifications in Microparticles from Asteroid Ryugu

a: Image of particle C0105-03004800 collected from TD2

The observed particle consists of a "frothy layer" and a "smooth layer." The inset in the upper right of Image a shows a magnified view of the frothy layer, while the inset in the lower left shows a magnified view of the smooth layer.

b: Image of particle A0104-02203700 collected from TD1

On the left side of this image, the frothy layer partially covers the smooth layer. The boundaries between these two distinct types of layers are indicated by dashed lines. Melt splash can be observed in the lower-center of the image, adhering to the surface of the frothy layer.

Research Overview

Asteroid Ryugu is a C-type asteroid that preserves information from the early solar system. Samples returned by the Hayabusa2 mission revealed a dual nature: surface dehydration and the presence of hydrated minerals in the interior. Published research identified traces of space weathering—such as smooth and frothy layers caused by solar wind and micrometeoroid impacts—which provide critical evidence explaining the dehydration of Ryugu's surface layers.

Use of the Osmium Coater

To observe the fine microstructure of Ryugu particles with high precision, the Neoc-Pro Osmium Coater was used to form a conductive coating. Its ability to create an ultra-thin, uniform osmium film contributed significantly to capturing high-resolution SEM images of these precious extraterrestrial materials. Analysis confirmed that the primary mineral phases are hydrated phyllosilicates. Furthermore, samples from the first and second touchdown sites (TD1 and TD2) exhibited space weathering–related surface modifications, such as smooth and frothy layers, in several percent of the particles. These features resemble those of CI chondrites, the most primitive materials in the solar system. The uniform conductive film produced by the Neoc-Pro Osmium Coater proved highly effective for observing these delicate surface structures without causing damage.

Testimonial

"In this research, we used the Neo Osmium Coater to observe the surface structure (space weathering) of particles derived from the asteroid Ryugu at high resolution. Because Ryugu particles are highly prone to charging and feature numerous fine surface irregularities, forming a uniform conductive coating was essential for obtaining high-quality images. The Neo Osmium Coater demonstrates excellent coverage even on highly uneven samples, creating an ultra-thin, uniform osmium film. This allowed us to observe the samples without damaging their delicate original microstructures. As a result, we were able to clearly identify features such as smooth and frothy layers on the particle surfaces, contributing significantly to the understanding of space weathering processes."

Data provided by:

Professor Takaaki Noguchi, Department of Earth and Planetary Sciences, Graduate School of Science, Kyoto University

Associate Professor Masaaki Miyahara, Graduate School of Advanced Science and Engineering, Hiroshima University

Source:

Noguchi, T., Matsumoto, T., Miyake, A. et al. A dehydrated space-weathered skin cloaking the hydrated interior of Ryugu. Nat Astron 7, 170–181 (2023). https://doi.org/10.1038/s41550-022-01841-6

Uniform and Flawless Thin-Film Coating

Observation of Drosophila Cuticle Nanostructure

The high-precision osmium film enables vivid visualization of cuticle nanostructures, even at high

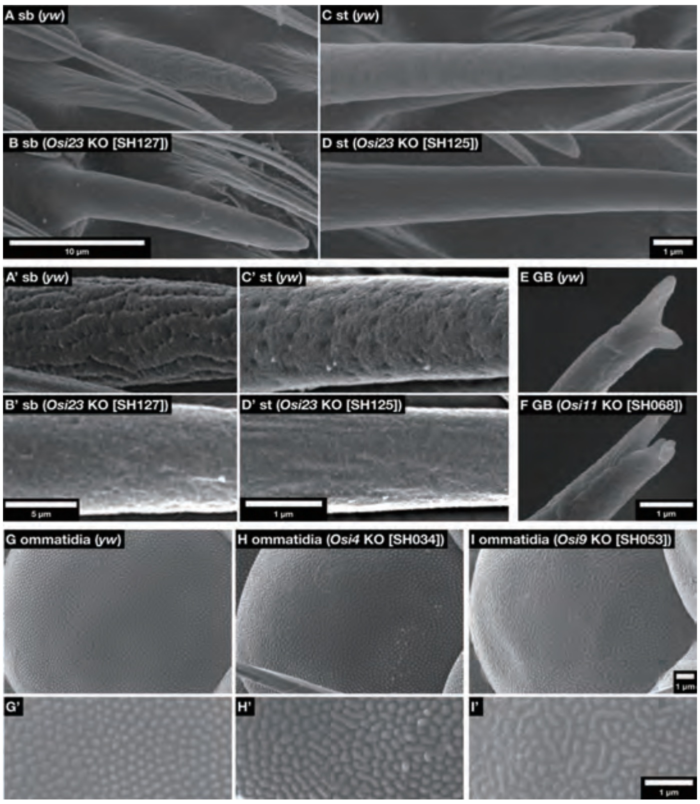


Fig. 1. Effects of Osiris gene mutations on cuticle nanostructure formation.
(A, B) SEM images of olfactory organs on the antennae (sb, A, A', B, B'; st, C, C', D, D'). Nanopores in sb and st are lost in the Osi23 mutant.
(E, F) Branched tips of gustatory organs. In the Osi11 KO, each tip shows further branching.
(G-I, G'-I') Surface topography of the retinal lens. Nipple array structures, which are individually separated in the control (G), are laterally fused in Osi4 and Osi9 mutants.
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Data provided by Dr. Shigeo Hayashi, Laboratory for Morphogenetic Signaling, RIKEN Center for Biosystems Dynamics Research

Research Overview

The insect exoskeleton, or “cuticle,” possesses intricate nanostructures linked to sensory functions; however, the mechanisms underlying their formation have remained poorly understood. This research revealed that in the cuticle-secreting cells of the Drosophila head, the insect-specific Osiris gene family is widely expressed during the initial stages of secretion. It was demonstrated that different sets of genes in each cell type determine the specific cuticle structure. Because genetic mutations result in cuticle defects, the findings suggest that Osiris genes play a crucial role in nanostructure formation.

Use of the Osmium Coater

To observe the nanoscale structures of the Drosophila head in detail for functional analysis of the Osiris genes, high-magnification observations were conducted using FE-SEM (JSM-IT700HR, JEOL Ltd.). The Tennant20 Osmium Coating System was used for sample preparation. It played a vital role in forming a thin, uniform conductive film on cuticle surfaces—such as the antennae, mouthparts, and compound eyes—which feature complex, irregular geometries.

This osmium coating suppressed charging on highly non-conductive insect surfaces, enabling the acquisition of high-definition SEM images without damaging the delicate nanostructures. As a result, cuticle defects and structural changes caused by Osiris gene knockouts were captured with high reproducibility, contributing significantly to clarifying the specific role of each gene.

Testimonial

Visualizing fine nanostructures requires a uniform, consistent thin-film coating. The Tennant20 Osmium Coating System met these requirements, allowing us to reliably capture nanostructural changes in mutant samples.

Fig. 1. Effects of Osiris gene mutations on cuticle nanostructure formation.
(A, B) SEM images of olfactory organs on the antennae (sb, A, A', B, B'; st, C, C', D, D'). Nanopores in sb and st are lost in the Osi23 mutant.
(E, F) Branched tips of gustatory organs. In the Osi11 KO, each tip shows further branching.
(G-I, G'-I') Surface topography of the retinal lens. Nipple array structures, which are individually separated in the control (G), are laterally fused in Osi4 and Osi9 mutants. Reproduced under the Creative Commons Attribution License (CC BY 4.0).
Data provided by Dr. Shigeo Hayashi, Laboratory for Morphogenetic Signaling, RIKEN Center for Biosystems Dynamics Research

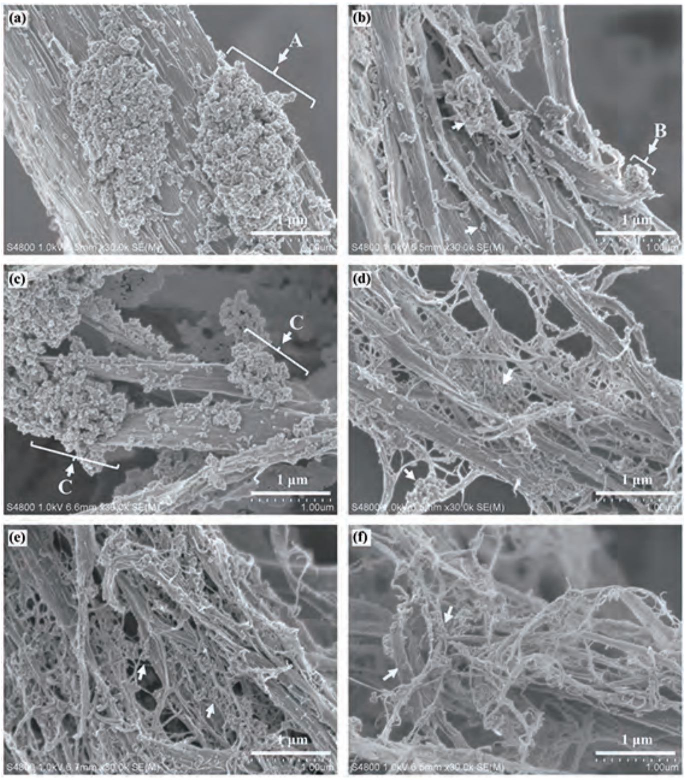
Features & Applications

Contributing to Cutting-Edge Research — Applications in Published Papers

Ultra-fine and complex morphology

Lignocellulose Nanofiber

Uniform coating of intricate details allows for clear observation of the 3D network structure of cellulose nanofibers (CNFs).The automated film-forming function ensures highly reproducible and efficient coating.



SEM images of quinacridone-lignocellulose fiber mixtures.
Mixtures of quinacridone and lignocellulose MF at ratios of (a) 2:1 (w/w) and (b) 1:9 (w/w).
Mixtures of quinacridone and lignocellulose NF at ratios of (c) 2:1 (w/w), (d) 1:1 (w/w), (e) 1:4 (w/w), and (f) 1:9 (w/w).
Arrows indicate quinacridone particles.

Data provided by Dr. Takashi Endo, Dr. Keita Sakakibara, and Dr. Yasuko Saito; Cellulose Materials Research Group, Research Institute for Sustainable Chemistry, Department of Materials and Chemistry, National Institute of Advanced Industrial Science and Technology (AIST) Chugoku Center.

Source: Saito, Y., Sakakibara, K., Tanaka, Y. et al. Influence of hemicellulose and lignin on intermolecular interaction between quinacridone and lignocellulosic fibers revealed by gel-state NMR and color measurements.
J Wood Sci 69, 20 (2023).
https://doi.org/10.1186/s10086-023-02094-1

Research Background and Overview

Quinacridone, a common pigment, suffers from reduced color performance due to particle aggregation. In this study, the effect of lignocellulose fibrillation (refinement) on suppressing quinacridone aggregation was evaluated using scanning electron microscopy (SEM).

Use of the Osmium Coater

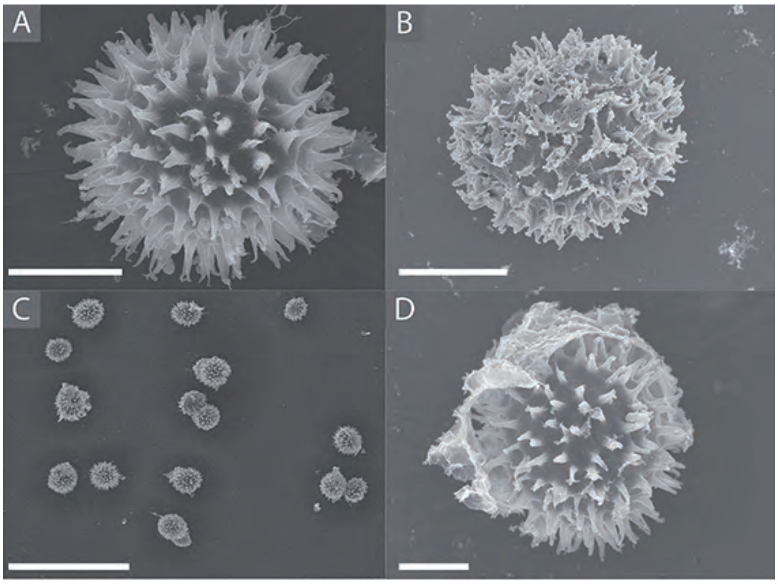
The Tennant20 Osmium Coating System was used to form a conductive film during sample preparation for SEM observation of lignocellulose and quinacridone samples. For lignocellulose nanofibers with ultra-fine and complex morphologies, the system forms a uniform osmium film that reaches every detail of the structure. Furthermore, its automatic thickness adjustment function enables highly reproducible coating.
Observations using a high-resolution field emission SEM (S-4800, Hitachi High-Tech, Tokyo, Japan) provided clear images without charging, allowing detailed confirmation of the quinacridone dispersion state. Secondary particles of 1 µm or larger were observed in mixtures with lignocellulose microfibers (MF). However, it became clear that dispersion into primary particles progressed as the proportion of nanofibers (NF) increased. These results demonstrate that lignocellulose fibrillation contributes to the suppression of quinacridone aggregation.

Testimonial

"The Tennant20 osmium coating system provides excellent coverage of intricate details, enabling high-resolution observation even for samples with three-dimensional network structures such as cellulose nanofibers (CNFs). Additionally, its automatic thickness adjustment function allows for highly reproducible coating, improving experimental efficiency."

Ascospores

Damage-free coating that prevents thermal damage to samples
Contributes to improving the morphological observation process of ascospores via SEM



A. SEM image of Tuber rugosum ascospore having been passed through the digestive system of the dusky arion slug.
B. SEM image of T. rugosum ascospore cleared from ascus by drying down ascocarp and scraping gleba.
C. Representative cluster of T. rugosum ascospores subjected to the slug digestive system.
D. Example of remaining ascus, digestive remnants, or other unknown tissue observed on a few of the T. rugosum ascospores SEM-imaged after slug digestion.
Bars: A, B, D = 10.0 µm; C = 100.0 µm

Data provided by Dr. Stanley Flegler (Director, Center for Advanced Microscopy), Dr. Gregory Bonito, and Dr. Zhi-Yan Du, Michigan State University

Source:RENNICK, B., et al.Tuber rugosum, a new species from northeastern North America: Slug mycophagy aides in electron microscopy of ascospores. Mycologia, 2023, 1-17.

Research Overview

The genus Tuber comprises ectomycorrhizal fungi known as truffles. Although many species possess spiny ascospores, numerous species remain undescribed. This study examines the morphological characteristics and molecular data of Tuber rugosum collected in North America to determine its species identity and clarify its taxonomic placement. In addition, a method for removing debris during SEM observation of ascospores is introduced, utilizing ingestion, digestion, and excretion by slugs.

Use of the Osmium Coater

The Neoc Osmium Coater was used to apply a conductive coating for SEM observation of T. rugosum ascospores. SEM imaging showed that the delicate protruding structures on the spore surfaces were well-preserved. The combination of a debris removal method using slug ingestion, digestion, and excretion, along with the uniform and stable conductive film provided by osmium coating, enabled the observation of the fine structures of the ascospores.

Testimonial

"The Tennant20 is extremely easy to operate and produces excellent SEM images. We are very satisfied with the osmium coating system and greatly appreciate the outstanding support provided during its installation at MSU."

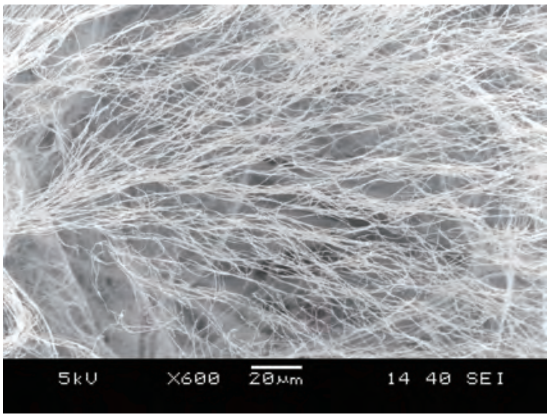
No Thermal Damage

Non-destructive Observation of Fragile Samples

Lyophilized Amino Acid Cake

Data provided by Professor Chikamasa Yamashita, Laboratory of Pharmaceutics, Faculty of Pharmaceutical Sciences, Tokyo University of Science

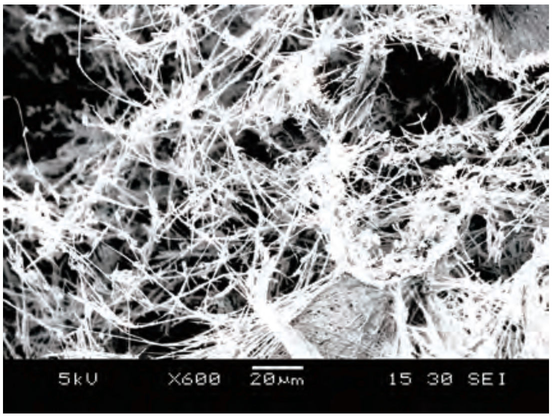
Osmium Coating



5 kV, 600x

Even for complex lyophilized cake matrix structures—which are prone to particle scattering and damage—the original morphology can be clearly observed without any structural compromise.

Sputter Coating

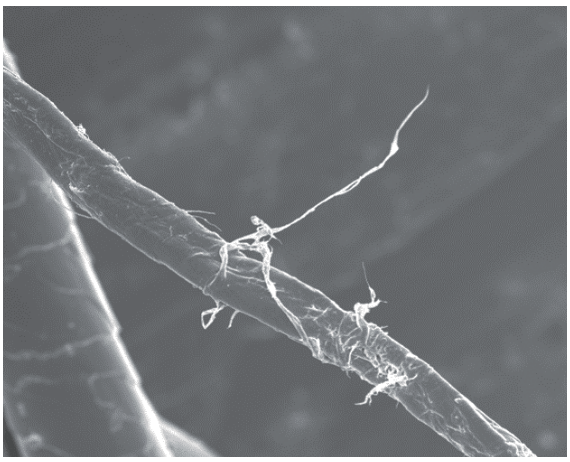


5 kV, 600x

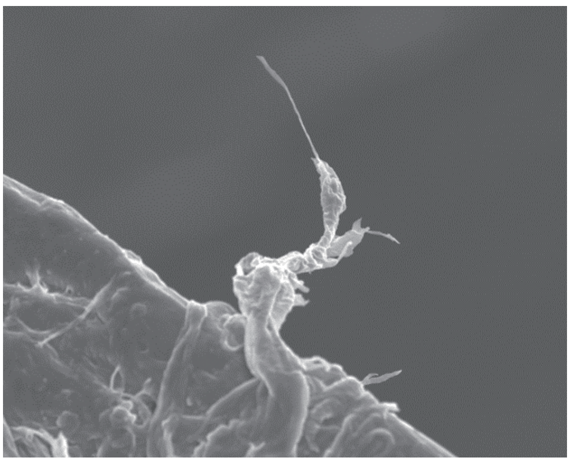
With platinum sputter coating, the network structure of the lyophilized cake was not clearly observable, and depth and shadowing remained unclear. In addition, the impact of sputtered particles led to issues such as collapse or fragmentation of the matrix structure.

Wolf Hair

In a wolf hair sample, the split and frayed cuticles are highly heat-sensitive and tend to curl or shrivel during sputter coating. In contrast, osmium coating causes no thermal damage, allowing clear observation right down to the very tips.



1,000x



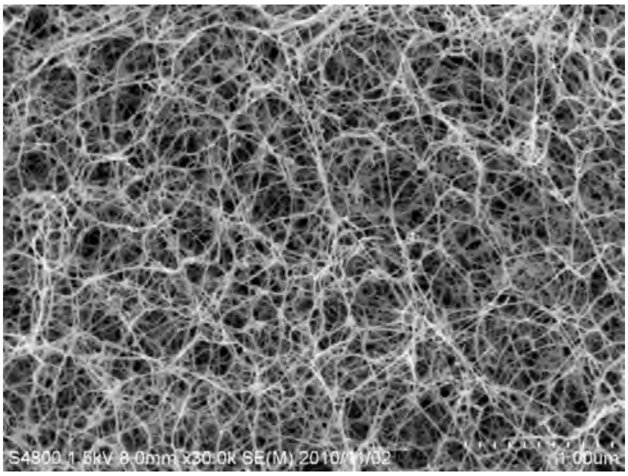
5,000x

No Electron Beam Damage

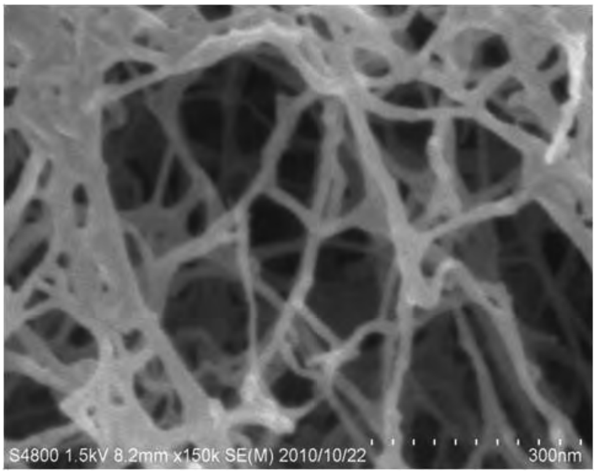
Observation of Deep Fiber Structures

Cellulose Nanofibers

The coating penetrates deep into the nanofiber network, enabling the observation of ultrafine fibers without breakage—something that was previously considered extremely difficult at the nanoscale.
Data provided by Dr. Seung-Hwan Lee, Biomass Research Center, National Institute of Advanced Industrial Science and Technology (AIST)



30,000x



150,000x

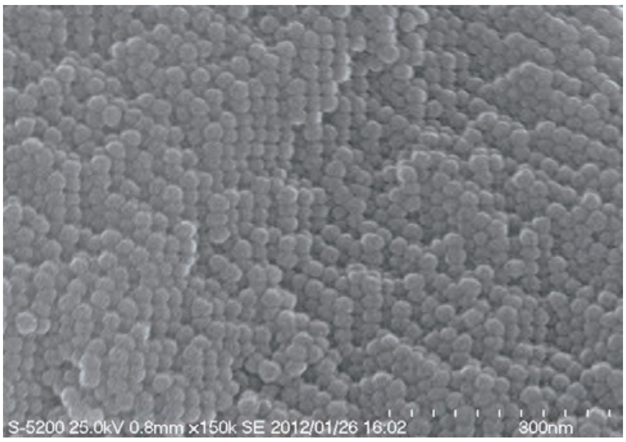
Clear Particle Differentiation with No Granularity

Silica Nanoparticles

While gold sputter coatings often obscure fine details due to their own grain structure—making it difficult to distinguish them from silica nanoparticles—osmium coating effectively eliminates charging. This enables clean, grain-free SEM imaging even at high magnifications of up to 150,000x.

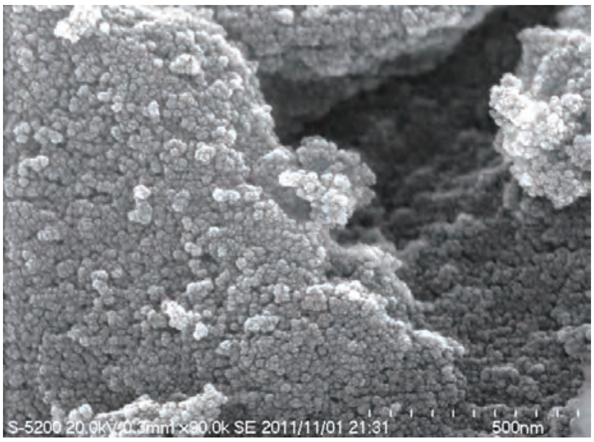
Data provided by Professor Daisuke Kawaguchi, Laboratory of Advanced Physical Chemistry, Graduate School of Engineering, Nagoya University

Osmium Coating



150,000x

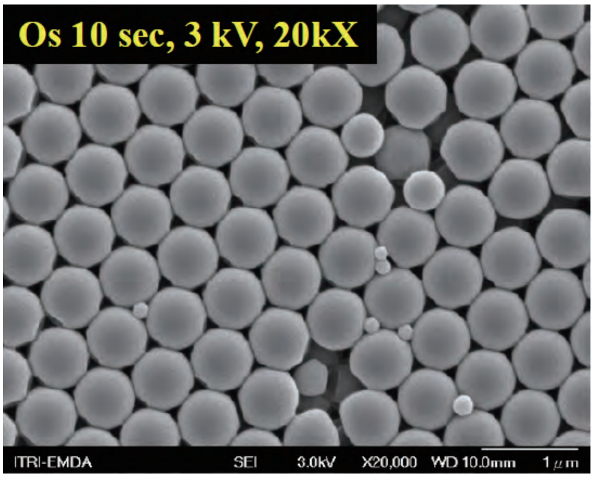
Sputter Coating



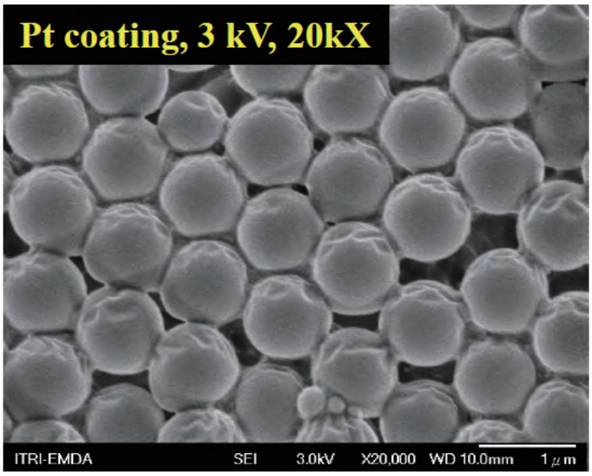
90,000x

Applications

No Granularity
Uniform Coating



Osmium Coating 20,000x

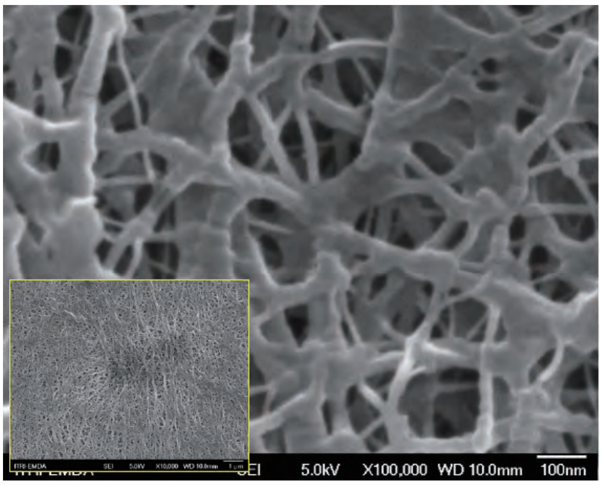


Sputter Coating 20,000x

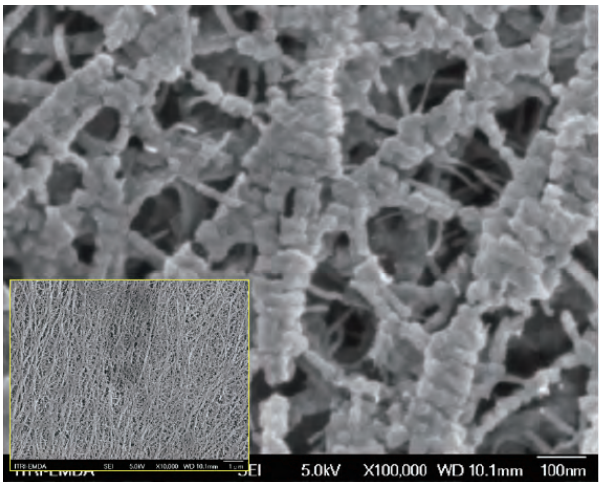
No Heat & Electron Beam Damage

Polymer Beads

The platinum-coated sample exhibited significant electron beam damage on the bead surfaces. In contrast, osmium coating -even as an ultra-thin film-enabled clear imaging with no observable damage and no charging.
Data provided by Industrial Technology Research Institute (Taiwan)



Osmium Coating 100,000x



Sputter Coating 100,000x

No Granularity Even at High Magnification

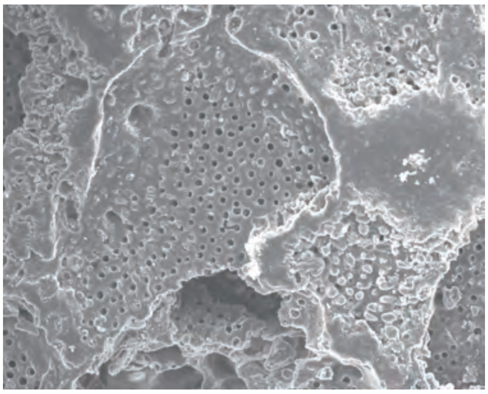
Polymer Film

At 100,000x magnification, a clear difference in surface quality is observed. The platinum-coated sample shows an accumulation of platinum particles, which obscures the original surface structure. In contrast, osmium coating remains grain-free even at high magnifications, allowing the true surface morphology to be clearly resolved. In addition, the low-current process ensures no thermal damage, even for organic samples.
Data provided by Industrial Technology Research Institute (Taiwan)

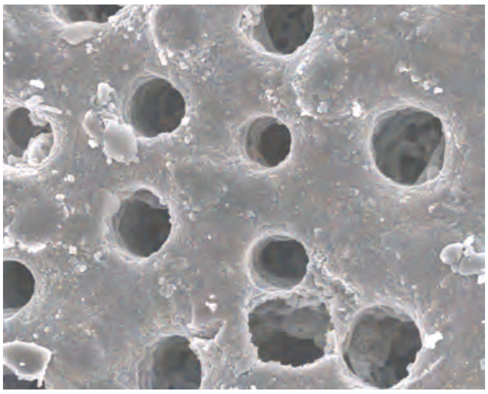
Excellent Coating Quality

Star Sand

Star sand is primarily composed of calcium carbonate, resulting in a highly porous surface. With sputter coating, surface irregularities tend to be filled in, making it difficult to resolve fine details at high magnification. The 10,000x image shows a view deep inside the pores observed in the 950x image.



950x



10,000x

Data provided by JEOL Ltd.

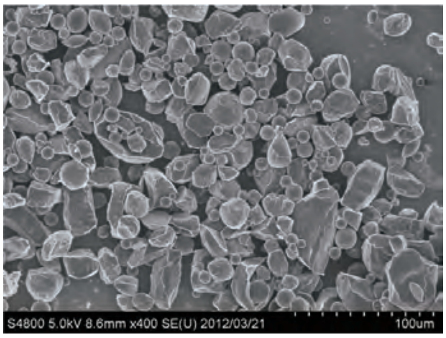
No Charging Even on Overlapping Samples

Polystyrene Particles

With platinum coating, charging occurs primarily where particles overlap, limiting magnification to below 2,000×. In contrast, osmium coating enables observation at 5,000×, clearly revealing fine details such as surface indentations formed during synthesis.

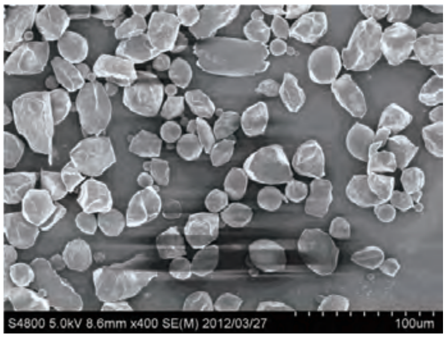
Furthermore, osmium coating prevents charging even in overlapping areas, allowing a complete overview of the sample with excellent contrast.

Osmium Coating (5nm)

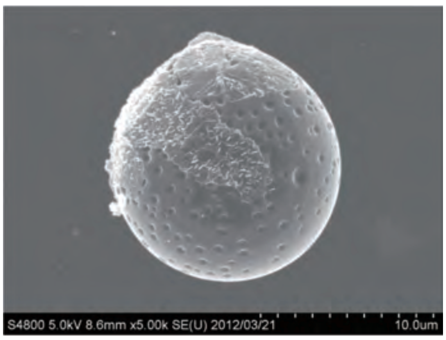


5kV, 400x

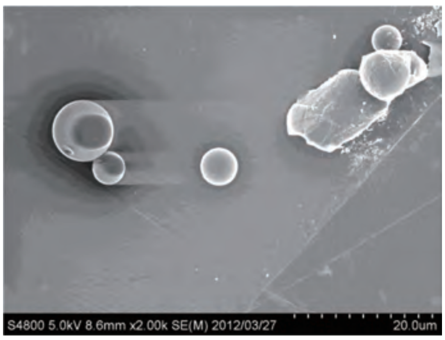
Platinum Coating (6 nm)



5kV, 400x



5kV, 5,000x



5kV, 2,000x

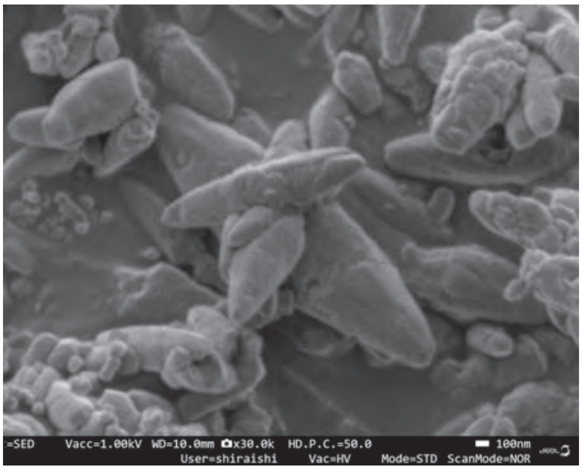
Data provided by Professor Hiroyuki Muto, Institute of Liberal Arts and Sciences, Toyohashi University of Technology

No Charging Even on Overlapping Samples

Calcium Carbonate Spindle-shaped Particles

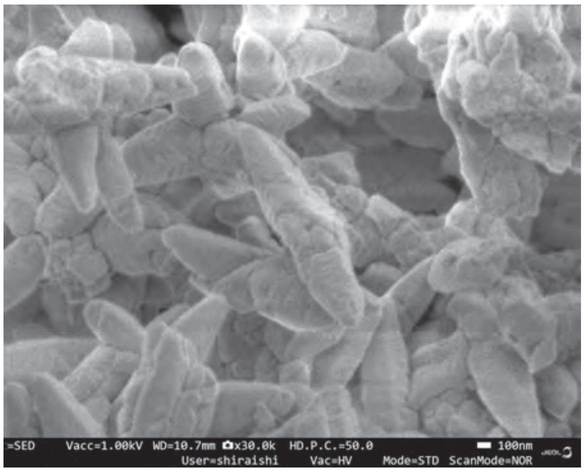
Calcium carbonate plays a vital role across various industries, including semiconductors and biotechnology. Accurately capturing its surface morphology and crystal structure is an essential step in maximizing its material properties.
The Tennant20 suppresses charging with a 5 nm osmium coating, enabling crisp, grain-free imaging even at high magnifications. This allows for high-contrast verification of ultra-fine surface details and significantly boosts research productivity by reducing overall observation time.

Osmium Coating (5nm)



1.0kV, 30,000x

Platinum Coating

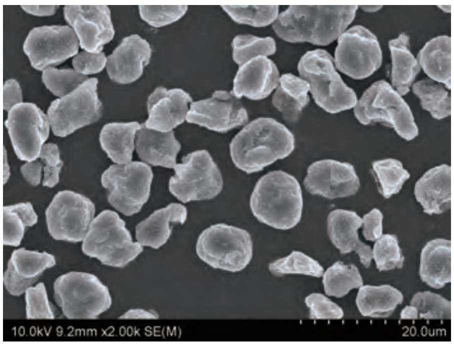


1.0kV, 30,000x

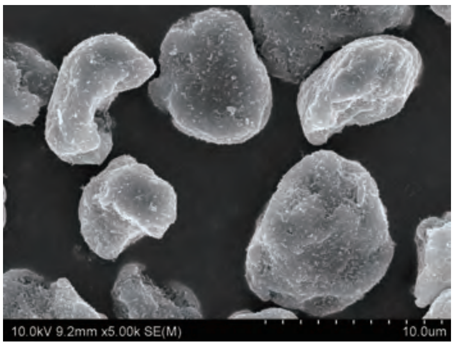
Data provided by SHIRAISHI CENTRAL LABORATORIES CO.,LTD

Toner Particles

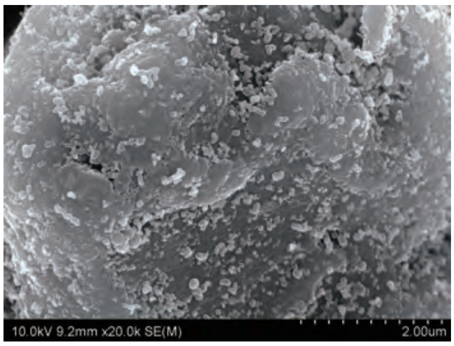
The fine surface irregularities and outlines of toner particles can be observed with high stability, even at higher magnifications. By suppressing charging, morphological differences and surface structures can be readily compared. Another key advantage is minimal interference with EDS analysis.
Coating Conditions: 3 nm Osmium Thickness / SEM: Hitachi High-Tech S-4800



2,000x



5,000x



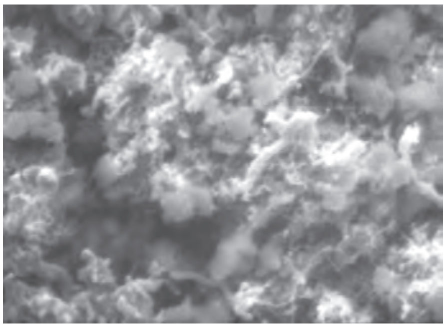
20,000x

High-Resolution Observation via Structural Reinforcement

Carbon Nanotubes (CNTs)

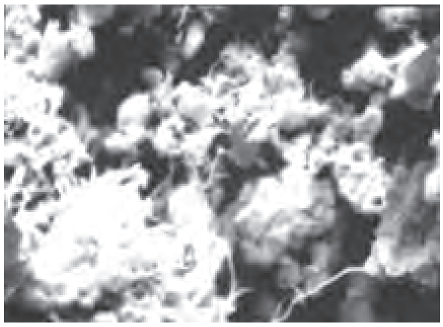
Even for carbon nanotubes with unstable morphologies, osmium coating provides a structural reinforcement effect, stabilizing the CNTs for SEM imaging and enabling high-resolution observation.
Furthermore, when uncoated CNTs are observed, they may become displaced or even “fly” during imaging, leading to contamination of the SEM detector. Osmium coating effectively prevents this. In a single process, it provides multiple benefits by suppressing charging and drift while protecting the detector from contamination.

Uncoated



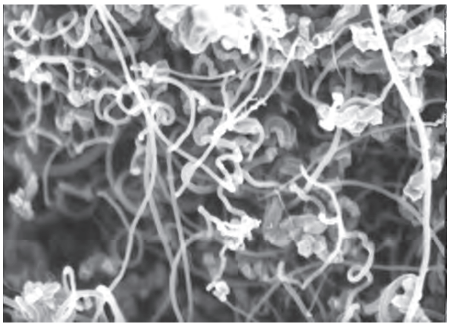
20,000x

Gold Coating



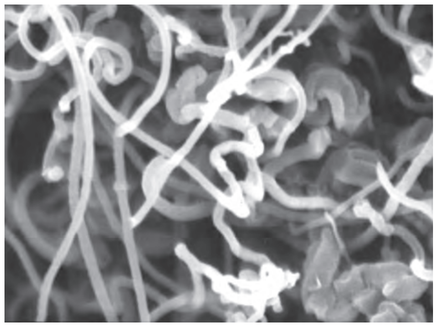
20,000x

Osmium Coating



20,000x

Osmium Coating



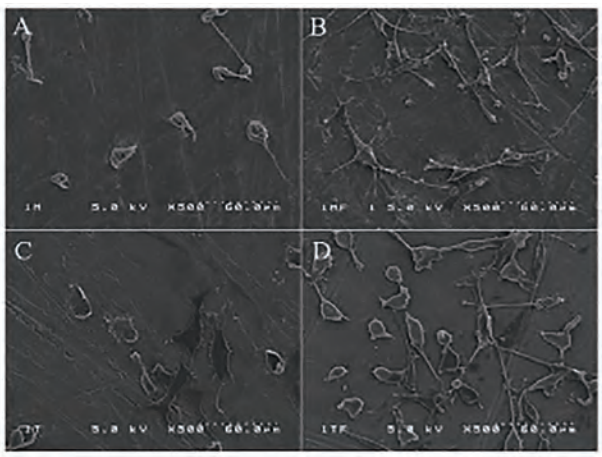
40,000x

Data provided by Ms. Tomoko Suzuki , Department of Materials Science and Engineering, Faculty of Science and Technology, Meijo University

Ideal SEM Preparation for Surface-Modified Titanium

Titanium Dental Implants

Most dental implants used in clinical practice are made of titanium. Their surfaces undergo various treatments, including sandblasting of mechanically polished surfaces, acid etching, and hydroxyapatite coating. These surface treatments increase the contact area between the implant and the surrounding bone.
At the cellular level, studies have shown that changes in the microstructure and chemical composition of the titanium surface promote the adhesion and proliferation of cells involved in osteogenesis.
At The Nippon Dental University, the Neoc Osmium Coater is used for SEM sample preparation when observing surface-modified titanium. The image on the right shows an SEM image of a titanium surface functionalized by H_2O_2 hydrothermal oxidation and FGF-2, taken 24 hours after cell seeding. The cell adhesion process can be clearly observed, with even the delicate pseudopodia extending from the cells remaining intact without breakage.



500x

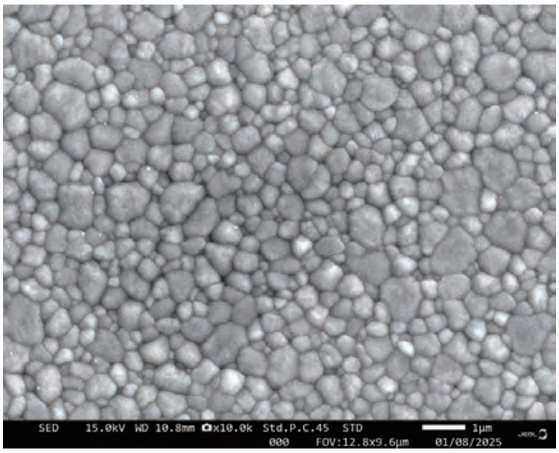
Data provided by Professor Tomonori Matsuno, School of Life Dentistry, The Nippon Dental University

Applications

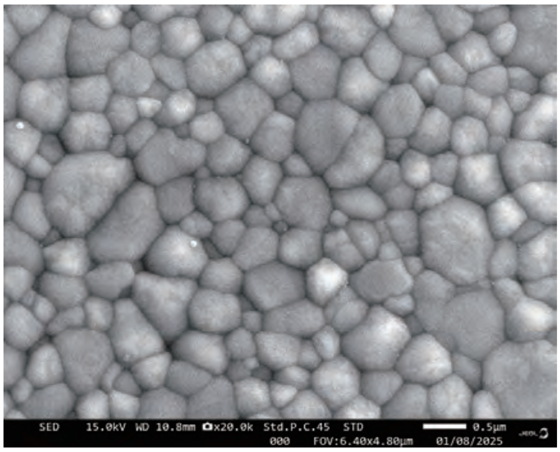
Clear Observation with No Granularity

Dental Zirconia (4 mol% Yttria-Stabilized)

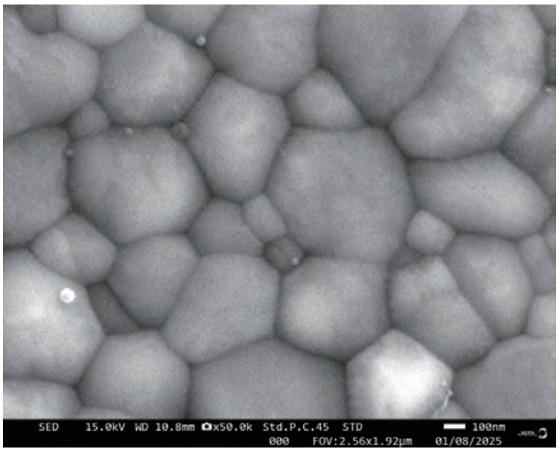
Osmium Coating (3 nm)
JEOL JXA iHP200F, Secondary Electron Image



10,000x



20,000x



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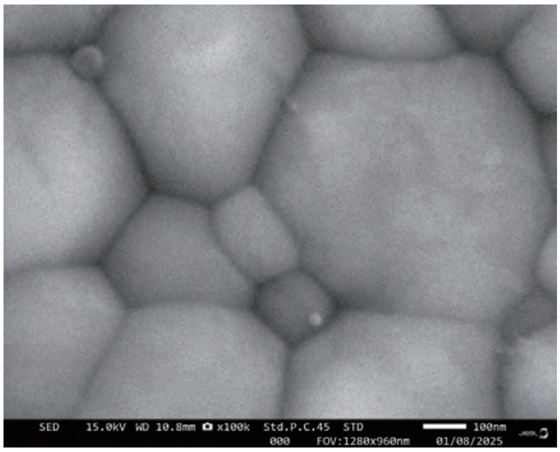


100,000x

Data provided by Professor Keisuke Nakamura, Division of Advanced Free Radical Science, Tohoku University Graduate School of Dentistry

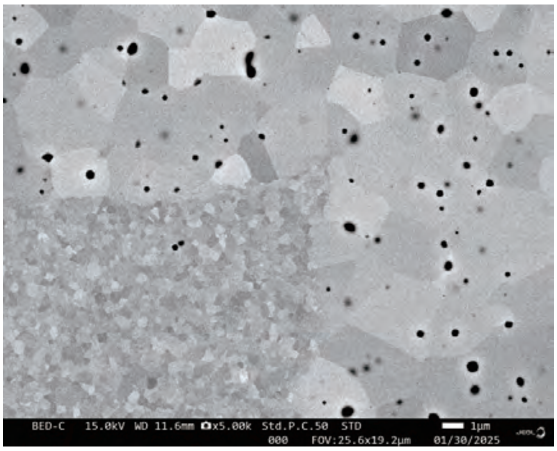
Zirconia is a high-strength ceramic, often referred to as "artificial diamond," and has gained significant attention in recent years as a material for dental restorations such as crowns and bridges. Dental zirconia typically contains small amounts of yttria to ensure structural stability.

■ Secondary Electron Imaging

As the yttria content increases, crystal grains grow larger, leading to reduced grain boundary visibility and enhanced translucency. Therefore, precise observation of crystal grains and grain boundaries by electron microscopy is essential.
To resolve these structures, thermal etching is commonly employed to reveal grain boundaries. However, because zirconia is non-conductive, conventional sputter coating typically requires a thickness of at least 15 nm to prevent charging. Such thick coatings can obscure the material’ s true structure, making observations at magnifications of ×50,000 to ×100,000 difficult.
By using an osmium coater, high-magnification imaging can be achieved with a coating thickness of only 3 nm, resulting in significantly clearer and more detailed images.

Dual-Phase Zirconia

Osmium Coating (3 nm)
JEOL JXA iHP200F, Backscattered Electron Image



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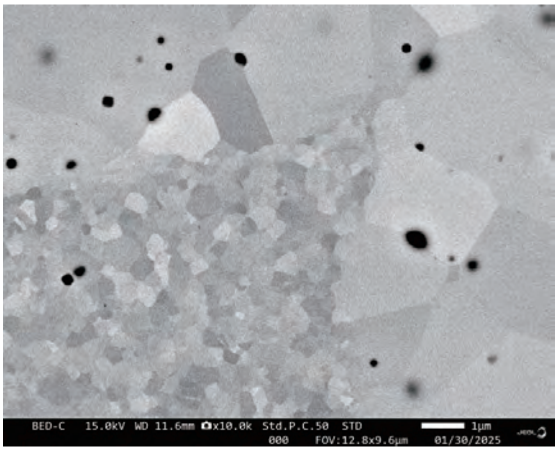
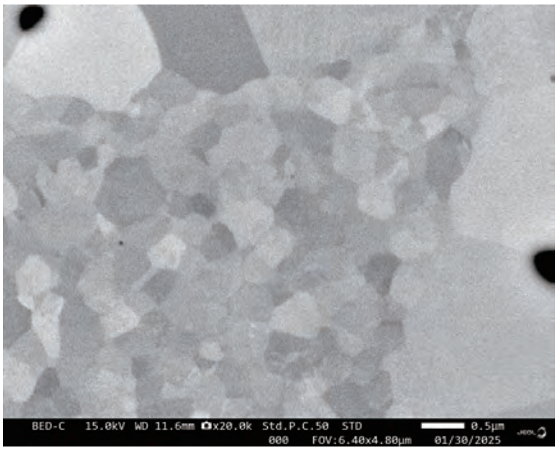


10,000x



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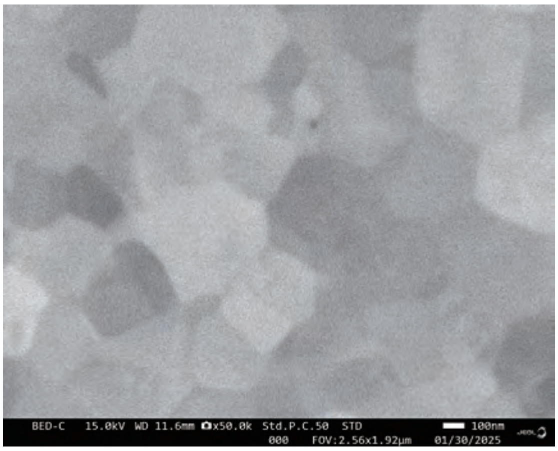


50,000x

Data provided by Professor Keisuke Nakamura, Division of Advanced Free Radical Science, Tohoku University Graduate School of Dentistry

■Backscattered Electron Imaging

These images show dual-phase zirconia, in which tetragonal (small grains) and cubic (large grains) crystal structures coexist. In backscattered electron imaging, contrast varies depending on the crystal orientation of the grains, enabling the observation of grain structures without the need for thermal etching.

The tetragonal phase in yttria-stabilized zirconia possesses a unique property known as the stress-induced phase transformation mechanism. When the material is subjected to stress that would normally cause microcracks, the tetragonal phase transforms into the monoclinic phase. This transformation generates compressive stress that suppresses crack propagation.

In contrast, the cubic phase exhibits high light transmittance, contributing to the improved aesthetics of the material. By controlling the ratio of tetragonal to cubic phases, dental zirconia can be designed to achieve an optimal balance between mechanical strength and aesthetic appearance.

In backscattered electron imaging observation, conventional sputter coating often hindered imaging because the coating layer absorbed backscattered electron signals required for clear contrast. However, by using an osmium coater, sufficient conductivity can be achieved with a thin film of only 3 nm. This enables high-magnification observation without artifacts, providing a clear and accurate view of the material's microstructure.

Versatile Options and Safety Features

Sublimation Cylinder Options

Our metal sublimation cylinders are designed for ease of use, making them accessible to all users.

For optimal performance based on usage frequency and gas emission characteristics, 500 mg and 1,000 mg (1 g) capacities are recommended for stable operation.

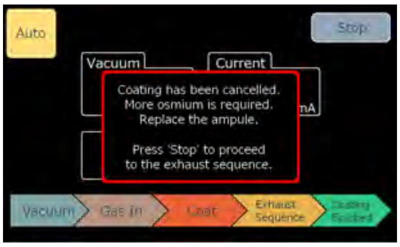
Metal Sublimation Cylinder

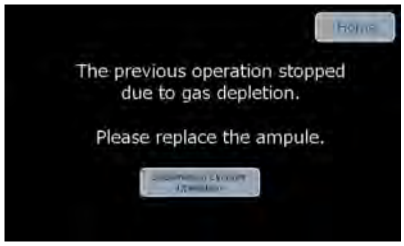
Osmium Ampules

500 mg 1000 mg (1g)

Automatic Ampule Replacement Alerts

The operation panel displays real-time notifications when it is time to replace the osmium ampule.
The intuitive interface guides any user through the replacement process, ensuring a smooth and hassle-free experience.



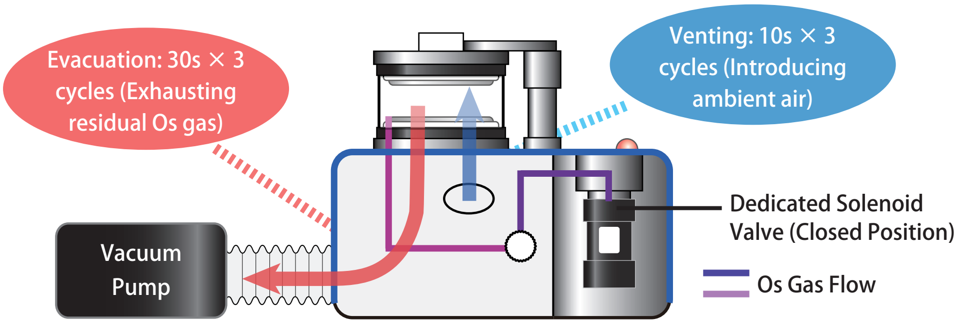


Restricted Access via Passcode

The Tennant20 is quipped with a passcode-based user management system. This security and administration feature ensures that only authorized users can operate the device. Operation logs are automatically recorded upon passcode entry. This allows for a comprehensive review of usage history, eliminating the need for manual record-keeping.

Automated Exhaust Sequence for Reliable Safety

By incorporating an automated exhaust sequence that replaces residual Os gas with ambient air after coating, the system prevents users from forgetting the purge process. This ensures that samples can be removed safely.

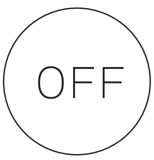


Dedicated Solenoid Valve for Osmium Gas

A dedicated two-way solenoid valve is installed between the sublimation cylinder and the chamber. The system features a fail-safe design that automatically closes the valve in the event of a power outage, preventing gas leaks even in emergencies.

Vacuum Hold Function During Power-Off

The system allows for shutdown while maintaining a vacuum state, preventing the chamber from atmospheric exposure after osmium use.



Chamber Dimensions	φ150×70mm
Sample Stage Capacity	φ10mm x35, φ15mm x10, φ30mm x5
Bell Jar	High-vacuum O-ring seal type
Pump Capacity	50 L/min
Current Consumption	AC 100 V, Max 10 A (including vacuum pump startup)
Max Power Consumption	780W
External Dimensions	390(W) × 385(D) × 435(H) mm
Weight	22 kg
Sublimation Cylinder Open/Close Detection	○
Touch Screen	○
Vacuum Hold Function During Power-Off	○
Automatic Purge	Ambient air replacement in chamber (Evacuation: 30s / Pump stop: 10s x3 cycles)
Current Setting	0.1 to 20.0 mA (Max limit current: 30 mA)
Film Thickness Setting	From 0.5nm
Auto	Film thickness setting
Manual	Custom settings for coating time, current, and gas filling time
EJECT	Forced exhaust: 180 sec
INSERT	Forced exhaust: Up to 2Pa
Finish	Forced exhaust: Up to 2Pa
Ampule Replacement	Forced exhaust: Up to 2Pa + 30 min
Automatic Deposition Function	○

Reliable Support You Can Count On

We are committed to providing high-quality support so you can continue using our equipment with confidence long after your purchase.
Our experienced technicians deliver optimal maintenance tailored to your system's specific condition.
Please feel free to reach out to us whenever you need assistance.

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