Filgen®
biosciences & nanosciences

Vacuum Electron Staining Apparatus

For safe and reproducible electron staining on electron microscopy samples

Filgen, Inc.

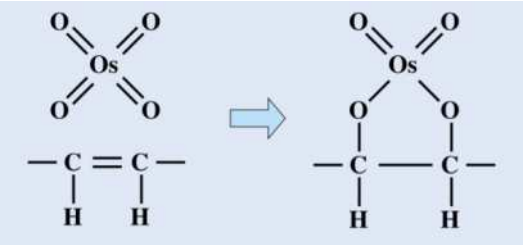
Overview

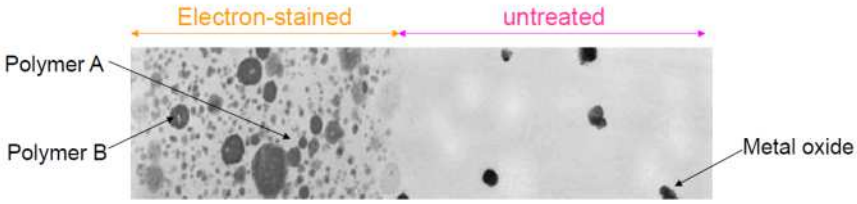
High reproducibility and safely operations

Principles

What is electron staining?

Electron staining is a method for enhancement image contrast of electron microscopy specimens which are composed with light element (eg. polymer materials, biological specimens etc.), by binding heavy metals. For polymer specimens, osmium tetroxide (OsO_4) and ruthenium tetroxide (RuO_4) are often used





A transmitted electron microscopy image of electron-stained and untreated specimen, composited

What is “vacuum” electron staining?

Conventional electron staining is performed under atmospheric pressure by exposing specimen to gaseous OsO_4 or RuO_4 or immerses it to those solutions. However, it often causes overstaining or lack of reproducibility. Also, there is a risk for operators to expose to those staining agents which are highly poisonous.
In contrast, our patented technology, vacuum electron staining enables more precise and safer staining by performing staining in vacuum. Staining time and gas pressure (that is, density of staining agent) in reaction chamber as well as timing of gas introducing and exhausting are automatically controlled.

Benefits

Safe operation

Conventional Risk for exposure to toxic staining agent with high sublimability. Drafter is required.

Vacuum No chance to exposure to toxic substance, with closed system and multiple safety measure.

High reproducibility

Conventional Unable to control density of staining agent, over staining occurs by remained gas.

Vacuum Automatic and precise control for staining time and density of agent. Eliminates over staining.

Effective for hygroscopic specimens

staining is performed by dry gas generated from OsO4 crystal (not aqueous solution)

Rapid and deeply staining

Less surface contamination

For determining optimal condition

Different staining time or density of agent can be set *only on 4-chamber model.

Stain without atmospheric exposure

Air isolation chamber, middle, top-front view

Air isolation chamber, mini and main unit

Applications

For SEM/TEM samples

- Enhancement image contrast for polymer specimens
- Fixation for polymer specimens before ultramicrotome sectioning
- Reduction of outgassing from specimens at in electron microscope chamber

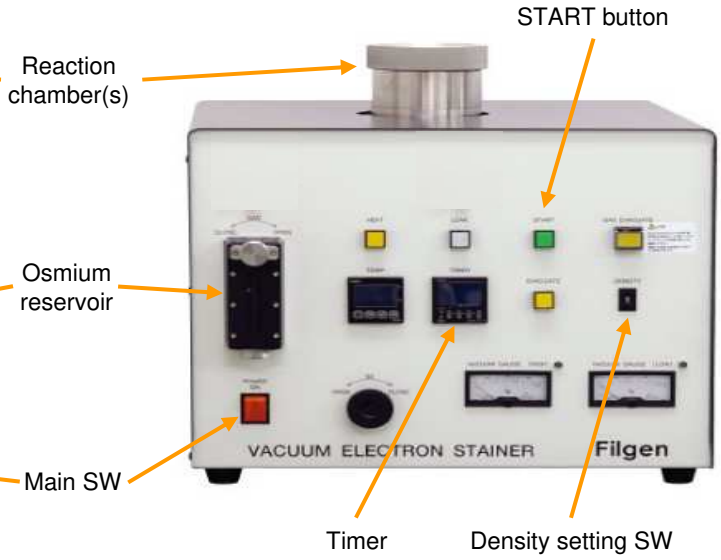
For SEM samples

- Elimination or reduction of charging effects on non-conductive specimens
- Embrittilement of specimens before fracturing

Product appearance

Model# VSC4TWDH

Model# VSC1R1H



High-resolution interactive touch panel controller

*only on model# VSC4TWDH

Easy and institutive operation by step-by-step visual guide

Save usage of staining agent thanks to the function which activate/deactivate chambers individually

Easy to confirm staining settings anytime from slide-in tab

* Images are from Japanese model. English version is available.

Details

Operation flow

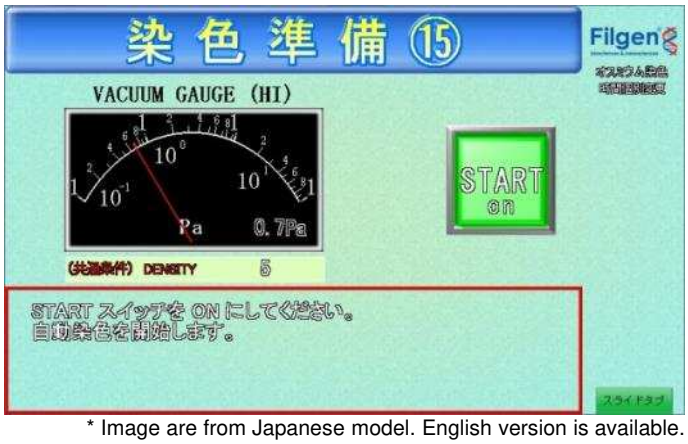
Whole process is completed by just press START button after setting of time and gas density.

Setting

Staining

- Place samples in chamber
- Set staining time and gas density
- Press START button to start staining
- Sublimated OsO_4 is automatically introduced to chamber
- OsO_4 gas in chamber is automatically exhausted after the elapse of setting time

With the model# VSC4TWDH, all operation can be made easily by step-by-step guide on thouchpanel screen.



* Image are from Japanese model. English version is available.

Safety measures

Interlocking system with reaction chamber

i. unable to open the chamber unless OsO4 is exhausted
ii. unable to introduce OsO4 when the chamber open

Osmium absorption filter

Not require any ventilation systems. Osmium concentration in exhaust gas is confirmed as safe level or lower by a third-party organization

Multiple safety features on Os reservoir

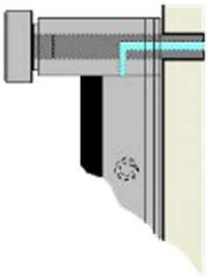
i. Gas-tight and robust design
ii. Gas port integrated locking pin (see below)
iii. Built-in ampoule cutter.
iv. Detachable and capable to store in freezer

Failsafe system against power cut

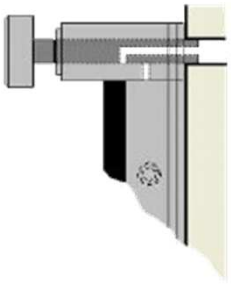
No chance to leak OsO4 gas when power is cut and recovered

Mechanisms of OsO_4 reservoir

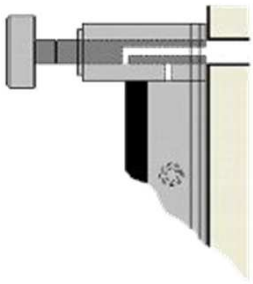
The gas port integrated locking pin of reservoir can simultaneously control status for reservoir locking and gas supply in safe.



Full-opened (during operation)
Reservoir: locked (undetachable) by manually inserted locking pin of reservoir
OsO_4 gas: can be introduced (depends on solenoid status)

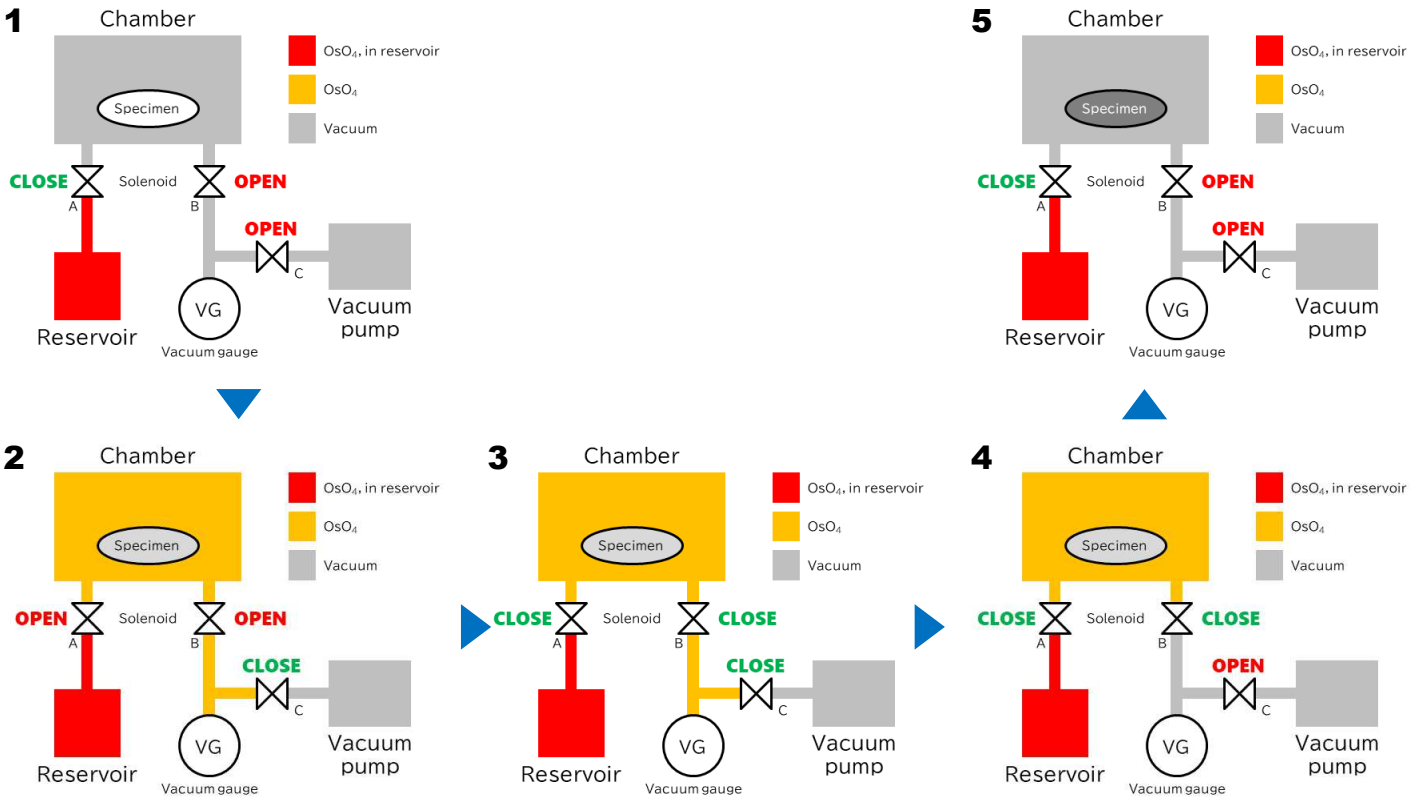


Half-closed (before reservoir detach)
Reservoir: locked (undetachable) by manually inserted locking pin of reservoir
OsO_4 gas: blocked *residual gas in the inlet pipe must be evacuated at this step



Full-closed (after operation)
Reservoir: unlocked (detachable)
OsO_4 gas: blocked

Process of vacuum electron staining



1. **Before processing**
   - OsO_4 is not introduced to chamber
   - Chamber is in vacuum
2. **Gas introduction**
   - Solenoid A is opened, and C is closed, just after start of the process
   - Sublimated OsO_4 is introduced in chamber gradually
3. **Gas density adjustment**
   - All solenoids are closed after OsO_4 density reaches to set level
4. **Staining**
   - Now staining is running in closed chamber
   - Solenoid C is opened and OsO_4 in piping is evacuated
5. **Post staining**
   - After the elapse of set staining time, solenoid B is opened and all residual gas is evacuated

Comparison: Vacuum electron staining vs. conventional

	Vacuum electron staining	Conventional method
1. Before processing	Inside of specimen as well as chamber are maintained vacuum	Under normal pressure
2. Gas introduction	Staining gas is immediately permeate to inside of specimen by high difference of pressure.	Longer time is necessary to permeate staining gas to inside of specimen.
3. Gas density adjustment	Gas density is automatically adjusted to set level (1-10 level)	Difficult to precise control of gas density
4. Staining	Density of staining gas is maintained by gas-tight chamber with solenoids	
5. Post staining	Remaining gas inside specimen is sucked out by negative pressure	Staining gas is remained inside of specimen.

Products

Specifications

Model#		VSC4TWDH	VSC1R1H
Interface		Interactive touch panel control	Mechanical switches, knobs, digital timer/temp controller, and analog vacuum meters
Staining agent		OsO_4 (crystals) in glass ampoule	
Density of staining agent		1-10 degree	
Staining time		1 min to 17hr	0.0-999.9 min
Reaction chamber	Number	4	1
	Inner size	86(ID) x 50(H) mm	
	Observation window	✔ (upper side)	
	Heating system	✔ (RT to 70 degC)	
Reservoir	Number	1	
	Detachable	✔	
	Built-in ampoule cutter	✔	
	Observation window	✔	
	Storage temp. *after detaching	-20 degC to 4 degC	
Gas introducing/exhausting system		Automated control with vacuum gauge, solenoids, and vacuum pump	
Safety measure		- Fully automated control system with interlocking - Residual gas trap unit - Gas tight reservoir with built-in ampoule cutter	
Size		610(W) x 445(D) x 510(H) mm	450(W) x 425(D) x 445(H) mm
Weight		Approx. 50 kg	Approx. 30 kg
Vacuum pump	Type	Two-stage oil rotary vacuum pump	
	Actual pumping speed	200 L @50Hz	
	Size	170(W) x 515.5(L) x 249.5 (H)	
	Weight	31 kg	
Accessories		- Gas-tight OsO_4 reservoir, 1 pc. - Vacuum pump, 1 unit - Residual gas trap unit, 1 unit - Connecting parts - Cleaning kit - Instruction manual (English version, printed)	

Accessories

Air isolation chamber

Enables electron staining under anaerobic condition. Suitable for materials which have high activity or reactivity with oxygen or moisture (eg, Negative electrode materials of Li-ion battery). 2 different sizes are available

OsO_4 ampoules

TEM Grid Holder

Holds up to 8 pcs of TEM grid. Stainless steel made

Osmium reservoir

Detachable, equipped with safety features.

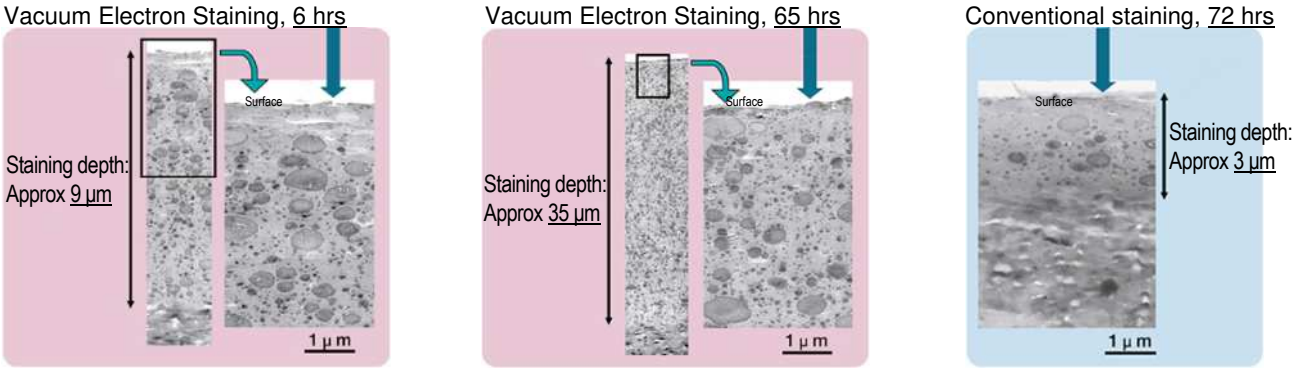
Transportation Container

Enable safer transportation for OsO4 reservoir. Stainless steel made.

Technical data

Technical data #1

TEM images of cross sectioned ABS, OsO_4 stained

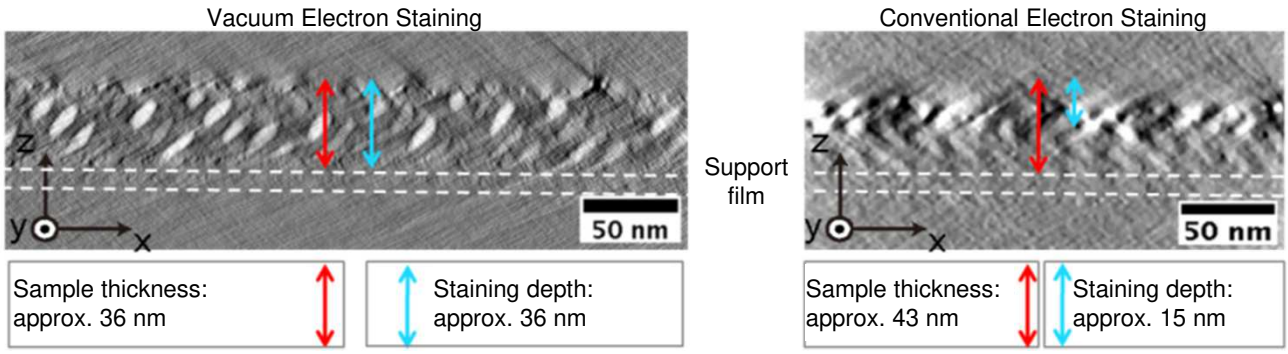


With Vacuum Electron Staining, deeper staining with shorter running time is possible.

Technical data #2

Reconstructed 3D images by electron tomography, RuO_4 stained

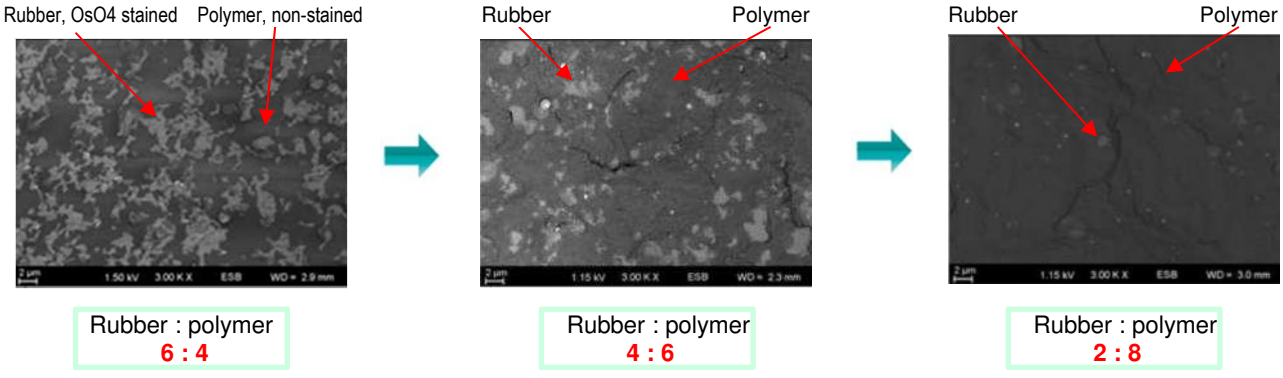
* Electron staining by RuO_4 is available only in Japan



With Vacuum Electron Staining, uniform staining is possible.

Technical data #3

SEM images of Rubber-dispersed polymer with different blend ratio, OsO_4 stained



With Vacuum Electron Staining, dispersion of polymers can be evaluated.

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