

SCD 005 Cool Sputter Coater



Features

Compact bench unit

Space saving unit with all controls and displays integrated into a single console.

Fine grained films

Very high resolution films can be achieved because of the possibility for a "carbon-metal-carbon" process (accessory) as well as optimal adjustment of the freely selectable sputtering parameters.

Absolute personnel safety

Designed according to the latest safety standards including such features as safety sputtering head, vacuum monitor, splinter shield and force-activated mechanical high voltage cut-off.

Easy and safe operation

One-button automatic operation, both preselectable and permanently stored sputtering parameters, analog / digital LED display with color pressure display for easy readout, LED mimic diagram and operating instructions printed on the unit make operation easy.

Very simple film thickness determination

The required film thickness can be pre-selected by using a film thickness curve, constant sputtering parameters and correct settings of the height adjustable specimen table.

Precisely reproducible film thickness

The thickness of evaporated or sputtered films can be determined precisely with a quartz crystal film thickness monitor (accessory).

Easy, quick target replacement

The hinged sputtering head with integrated piston damper and quick fastening system allow quick and simple replacement of foil targets.

Precise sputtering process sequence

The programmable timer starts running when the "START" key is switched on.

State-of-the-art electronics

All operating parameters are displayed digitally. The high voltage supply is current-stabilized and short circuit proof. The sputter parameters are not lost when the unit is turned off.

Service-friendly design

The use of plug-in modules, removable cover panels, and snap-on display and control panel turn maintenance into a simple user-friendly procedure.

Universal application

A wide selection of accessories allow the unit to be quickly equipped for a variety of preparation processes.

Cost-effective operation

The use of a solenoid valve that cuts off the argon supply, when the unit is turned off, prevents the costly loss of process gas.

Applications

In Scanning Electron Microscopy

- The production of conductive films on SEM specimens through the sputtering of Gold, Gold / Palladium, Silver and Platinum.
- The production of conductive carbon films on specimens intended for X-ray microanalysis (EDX, WDX) (accessory).
- The application of extremely fine grained metal films on a carbon based film deposited by evaporation in the same vacuum cycle (Carbon-Metal-Carbon process according to Prof. Blaschke for high resolution SEM) (accessory).
- Coating of large SEM samples such as Compact Discs or wafers as part of quality control in industrial processes (accessory).

In Transmission Electron Microscopy

- Normal and rotary shadowing of TEM specimens using the sputter-shadowing technique according to W. Colquhoun [1] (accessory).
- Application of carbon reinforcement films on specimen support grids with a collodium or formvar coating (accessory).

The Sputtering Method

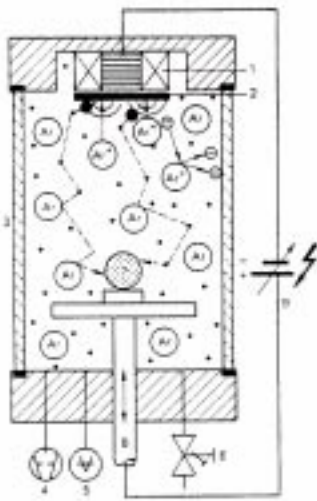
Argon gas is admitted through a gas dosing valve to a specimen chamber that has been evacuated by a roughing pump. Flushing the chamber several times with argon makes it easier to pump out undesired gases, particularly water vapor. After this flushing process, the atmosphere in the chamber should consist of as much pure argon as possible. A working pressure of between 0.05 and 0.1 mbar is then established in the chamber, and the sputtering process can be started.

To start the sputtering process, a high voltage is applied to the target (cathode). This produces a high voltage field between the target and the specimen table (anode). The free electrons in this field are forced into a spiral path by a magnet system where they collide with the argon atoms in the field. Each collision knocks an electron out of the outer shell of the argon atom, positively charging the otherwise neutral argon. This is a cascading process that causes a glow discharge (plasma) to ignite. The positively charged argon ions are now accelerated to the cathode (target) where they impinge, knocking out metal atoms as they hit. Collisions also occur between the metal atoms thus released and the other gas molecules in the vacuum chamber. This causes the metal atoms to scatter widely, forming a diffuse cloud. The metal atoms from this cloud impinge on the specimen from all directions and condense evenly on it. Thus even very fissured specimen surfaces are coated with an even, thin metal film that is sufficiently electrically conductive for examination in the SEM. Because of the high surface diffusion of their atoms, gold and silver tend to form "islands". Thus the desired electrical conductivity is not achieved until the film is at least 10 nm thick. Platinum produces films with the finest grains. The fine grained structure of the sputtered film is a function of the target material, the working distance, the gas pressure and the sputtering current as well as of the process duration.

In practical application however, the sputtering parameters must be chosen according to the heat load the particular specimen can withstand. Heat-sensitive specimens such as those of biological origin or plastic foams are thus sputter-coated from as long a working distance and as low a current as possible. Here one must take into account that the process must be correspondingly longer to achieve the same desired film thickness.

Modern scanning electron microscopes have extremely high resolving powers that often require very finely grained films. These can be achieved through the correct selection of the sputtering parameters or by first coating the specimen with a carbon film (refer to the carbon-metal-carbon accessory.)

The sputtering principle



- 1 Permanent magnet system
- 2 Target (cathode)
- 3 Vacuum chamber
- 4 Roughing pump
- 5 Vacuum gauge head
- 6 Argon gas inlet system
- 7 Specimen with metal film
- 8 Specimen stage (anode)
- 9 High voltage supply

- ⊕ Ar Argon atoms
- ⊖ e Electrons
- ⊕ Ar⁺ Argon ions
- Metal atoms
- Residual gas molecules

The Carbon Thread Evaporation Method

Please refer to our brochure on the CED 030 carbon thread evaporator (BU 800 189 PE) for a description of the carbon thread evaporation method.

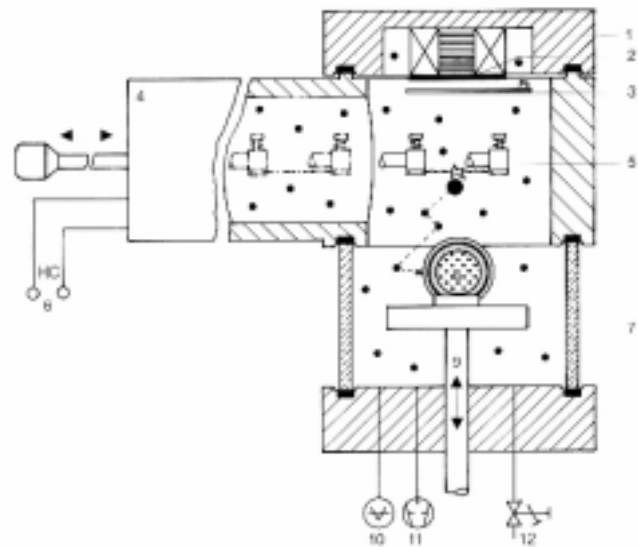
The Carbon-Metal-Carbon Evaporation Method

High resolution scanning electron microscopes often require extremely fine-grained films to fully exploit their magnifying power. The high surface diffusion of sputtered gold or silver films (formation of "islands") do not meet this requirement. The method developed by Professor R. Blaschke, Universität Münster allows very fine-grained electrically conductive metal films to be applied to the specimen by first coating it with carbon.

A double carbon thread evaporator is pushed into the middle of the vacuum chamber. The carbon thread is "flash" evaporated, which coats the specimen with a thin carbon film. The carbon thread holder is then pulled back from the chamber, and the standard sputtering process is started. At a thickness of only 5-7 nm the metal film already envelops the structures on the specimen surface.

As the well-known "island" formation becomes evident again when the metal film is exposed to atmospheric conditions for several days, a second carbon film serves as a "preservative" for the sputtered metal film. This carbon film is applied by pushing the carbon thread evaporator back into the chamber and "flashing" the second carbon thread. This method allows carbon-metal-carbon "sandwich" coatings to be applied without breaking the vacuum.

The C-M-C principle



- 1 Permanent Magnet
- 2 Target (cathode)
- 4 CGC 010 housing
- 5 Sliding carbon thread evaporator head
- 6 High current supply
- 7 Vacuum chamber
- 8 Specimen with carbon-metal-carbon coating

- 9 Specimen stage (anode)
- 10 Vacuum gauge head
- 11 Roughing pump
- 12 Gas inlet system
- Residual gas molecules
- Carbon atoms

The Sputter Shadowing Method

Our Technical Report Nr. BU 800 110 DE [1] contains the description of the method developed by W. R. Colquhoun, State University of New York.

The High Vacuum Sputter Method

Very fine-grained sputter coated films can be produced by this method. Undesired residual gas components such as water vapor are virtually eliminated from the vacuum chamber by a high vacuum pump. The working pressure required for sputtering - approx. 10^{-2} mbar - is then reestablished the chamber with the admission of argon gas.

This high vacuum sputtering method can be carried out in, for example, our MED 020, BAE 080 and BAE 250 high vacuum coating systems.

Technical Data

Dimensions

Unit		see scale drawing
Vacuum chamber:	Inner diameter	108 mm
	Height	106 mm
Specimen table	Diameter	84 mm
	Foil target	Diameter
Working distance	Thickness	0,2mm
	Minimum	22 mm
	Maximum	78 mm

Weight

Without vacuum pump	31 kg
---------------------	-------

Connection data

Electrical connection

Voltage (L+N+PE)	230 / 115 V
Frequency	50 / 60 Hz
Power consumption	100 VA
Main fuse for 230 V	1 A (slow blowing)
Main fuse for 115 V	2 A (slow blowing)

Process gas

Hose nipple connection	6 mm (G 1/8") diam.
Connection pressure	1 - 2 bar
Gas consumption	approx. 0,3 mbar l/sec.

Venting gas

Hose nipple connection	6 mm (G 1/8") diam.
Connection pressure	1 - 2 bar

Vacuum connection

Hose clamps	26 mm diam.
-------------	-------------

Operational data

Sputtering current	max. 75 mA
Open-circuit voltage	approx. 1000 V DC
Process time, adjustable	0 to 999 sec.
Pumping time at 5×10^{-2} mbar with a two stage rotary vane pump, pumping speed $5 \text{ m}^3/\text{h}$, and a 1.5 m long vacuum hose	approx. 2 min.

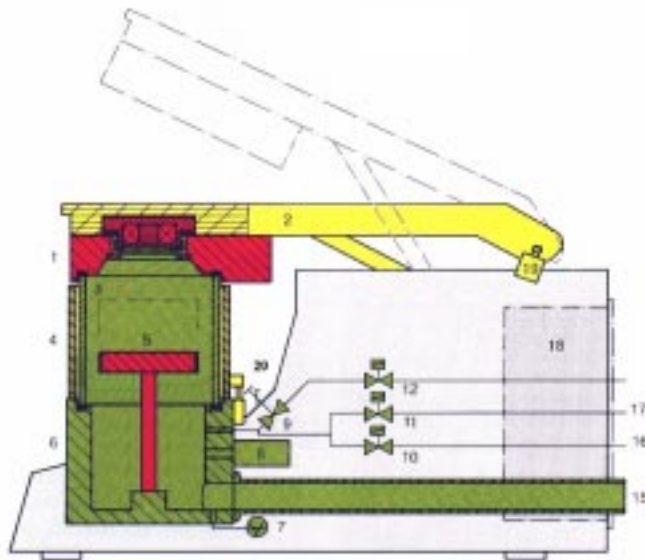
Roughing pump

Two stage rotary vane vacuum pump $5 \text{ m}^3/\text{h}$	
Pumping speed at 50 Hz	$5.4 \text{ m}^3/\text{h}$
Pumping speed at 60 Hz	3.8 cfm
Ultimate total pressure without gas ballast	$< 2 \times 10^{-3}$ mbar
Max. power consumption at operating temperature	450 / 550 VA
Weight	25 kg

Alternative 1

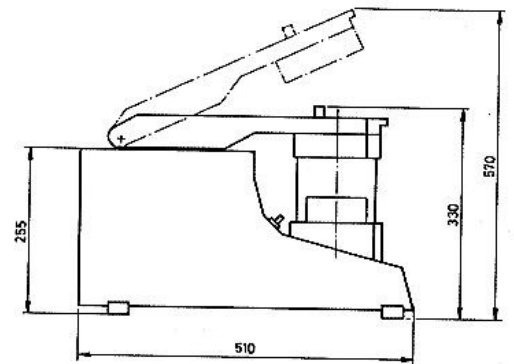
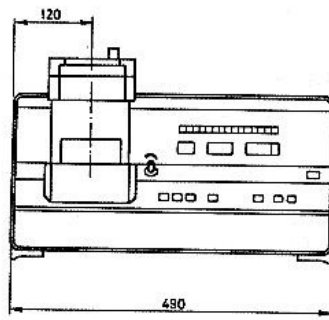
Two stage rotary vane vacuum pump $10 \text{ m}^3/\text{h}$	
Pumping speed at 50 Hz	$9.7 \text{ m}^3/\text{h}$
Pumping speed at 60 Hz	6.8 cfm
Ultimate total pressure without gas ballast	$< 2 \times 10^{-3}$ mbar
Max. power consumption at operating temperature	450 / 550 VA
Weight	26 kg

Design

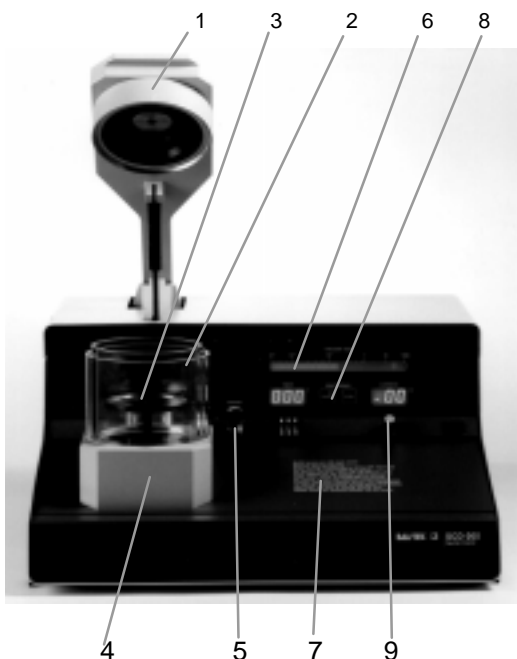


- 1 Target head with magnet system
- 2 Hinged arm with piston damper
- 3 Glass vacuum chamber
- 4 Splinter shield
- 5 Height-adjustable specimen table
- 6 Vacuum chamber base
- 7 Medium vacuum gauge
- 8 Vacuum switch
- 9 Gas dosing valve (manual)
- 10 Automatic venting valve
- 11 Rinsing gas valve
- 12 Automatic gas supply cut-off valve
- 15 Pumping port
- 16 Venting gas connection
- 17 Process gas connection
- 18 Control and supply modules
- 19 Safety separation switches (two)
- 20 Process selection

Scale drawing



Front view of the unit



- 1 Hinged target arm
- 2 Glass vacuum chamber with splinter shield
- 3 Height adjustable specimen table
- 4 Vacuum chamber base
- 5 Gas dosing valve, manual
- 6 Display panel
- 7 Printed-on short operating instructions
- 8 Touch-pad keyboard controls
- 9 Current knob

Specification

1. Housing

Consisting of:

- 1 Console housing
- 1 Hinged telescoping damping arm
- 1 Vacuum chamber base
- 1 Power fitting
- 1 VS 010 power pack
- 1 Panel with printed operating instructions
- 1 Pump fitting
- 1 Process gas fitting
- 1 Venting gas fitting

2. Vacuum chamber

Consisting of:

- 1 Sputtering table, adjustable in height
- 1 Glass chamber, ID 108 x 106 mm, with a scale for the working distance
- 1 Measurement feedthrough (for measurement of the quartz layer thickness or for a motor drive)

3. Rotary vane pump

For suitable rotary pumps, see accessories (not included in the basic equipment).

4. Vacuum measuring equipment

Consisting of:

- 1 TPR 010 Pirani measuring gauge
- 1 PP 010 Plug-in control unit

5. Gas inlet system

Consisting of:

- 1 Manual gas metering valve
- 1 Automatic venting valve
- 1 Manual "Flush" valve

6. Sputtering equipment

Consisting of:

- 1 HT 010 high-voltage power supply
- 1 Magnetron sputtering head
- 1 Target mounting device

7. Display and control panel

Consisting of:

- 1 Analog / digital LED vacuum display
- 1 LED real time display
- 1 Manual setpoint time display
- 1 Start key
- 1 Stop key
- 1 LED display for the actual sputtering current
- 1 Adjustable potentiometer for the sputtering current
- 1 "Flush" key

8. Safety equipment

Consisting of:

- 1 Vacuum monitor
- 1 Splinter shield with safety plug
- 1 Swivel arm safety switch
- 1 Mains filter
- 1 Central grounding system

9. Basic unit accessories

- 1 Set of accessories (BU 014 396 -T)
- 1 Set of tools (BU 014 397 -T)
- 1 Set of spare parts, electric, 220 V / 50/60 Hz (BU 017 858 -T)

Alternative

- 1 Set of spare parts, electric, 115 V / 50/60 Hz (BU 017 859 -T)

Ordering Information

SCD 005 basic unit per specification, items 1 to 9

(without target or rotary vane pump)

	Order No.
230 V / 50/60 Hz	BU G05 750
115 V / 60/60 Hz	BU G05 751

Accessories



Two stage rotary vane vacuum pump 5m³/h

Order No.

90-240 V / 50-60Hz B 8010 071 78

Two stage rotary vane vacuum pump 10m³/h

Order No.

90-240 V / 50-60Hz B 8010 072 00

Vacuum connecting hose

For connecting the scarbon evaporator to a rotary pump. One end has a DN 25 ISO-KF-28 hose connection.

Vacuum hose with embedded polyester coil, Ø 28 mm; length 1.5 m.

(Other dimensions available on request).

Order No. BU 007 152 -T



Oil mist filter OME 025S

For connecting to the exhaust line of the vacuum pump.

Prevents contamination of the ambient air with oil mist when no exhaust gas line can be connected.

Order No. B 8010 071 53

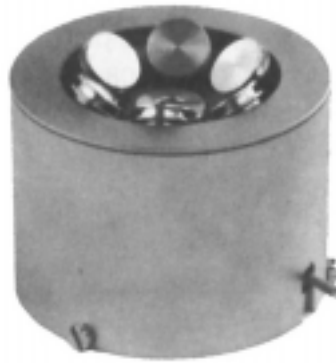


Sputter shadowing device for normal shadowing

This simple accessory permits shadowing of transmission electron microscopic (TEM) preparations by vapour deposition of an Au/Pd layer. Up to 12 preparations can be shadowed at one time with this device.

Another advantage of this method is the much shorter working cycle compared to high-vacuum sputtering, and also that the specimens are exposed to less heat. For additional information, please request our technical report "Sputter Shadowing Device and Process" BU 800 110 DE.

Order No. BU 007 163 -T



Planetary drive stage

Holds 6 SEM specimen mounts for Cambridge, Etec, Philips and Zeiss microscopes. 1,4 V battery included.

Order No. BU 007 162 -T

Spare 1,4 V battery

Order No. B 8010 077 76



Intermediate ring with vacuum chamber, complete

The intermediate ring with a measurement feedthrough is needed only when the planetary drive stage BU 007 288 -T and the film thickness measurement device are operated at the same time.

Consisting of:

- 1 Intermediate piece with a measurement feedthrough
- 1 Glass vacuum chamber, ID 108 x 60 mm
- 1 Splinter shield with safety plug

Order No. BU 017 175 -T



Sputter shadowing device for rotary shadowing effect

This shadowing device makes it possible to achieve a shadowing effect such as that obtained with conventional rotary shadowing, but without requiring a complicated specimens rotating device.

With the special shadowing accessories that can be used in a sputtering device, 6 preparations can be shadowed at the same time and the shadowing angle can be varied by means of a simple adjustment.

Order No. BU 007 164 -T



Planetary drive stage

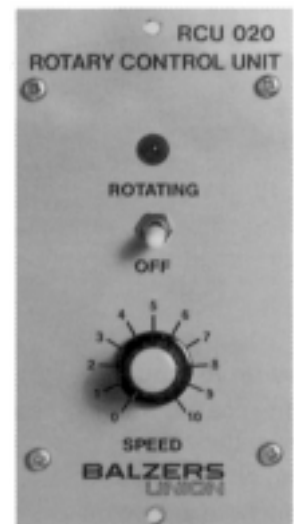
For uniform coating of highly fissured specimen surfaces.

Consisting of:

- 1 Housing with a drive motor
- 1 Mount for quartz measurement head
- 1 Connecting cable
- 10 Aluminium carriers, QJ 20 x 10 mm, to hold various SEM specimen mounts

The RCU 020 control unit is needed for the operation of this accessory.

Order No. BU 007 288 -T

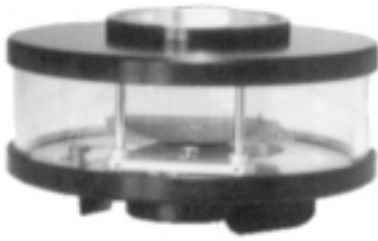


RCU 020 control unit

For control of the planetary drive stage (BU 007 288 -T)

Order No.

230 V / 50/60 Hz BU S01 262
115 V / 50/60 Hz BU S01 263



Special vacuum chamber DN 205

For coating large specimens such as wafers or compact disks for electron microscopy.

Maximum wafer size: 6" round or 5" square.

Consisting of:

- 1 Base plate and cover plate
- 1 Glass vacuum chamber DN 205 (BU 014 913)
- 1 Motor-driven preparation table, adjustable in height
- 1 RCU 020 control unit
- 1 Set of cables
- 1 Splinter shield with safety plug

Order No.

230 V / 50 Hz	BU 007 185 -T
115 V / 60 Hz	BU 007 186 -T



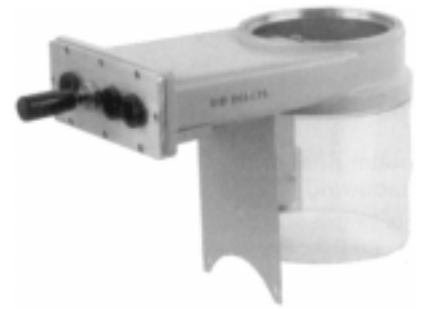
Single carbon thread evaporation flange

Consisting of:

- 2 High-voltage plug connections (BU 007 459 -T)
- 2 Quick-action clamps (BU 008 700 -U)
- 1 Rotating shutter

This evaporation flange is included in the basic equipment supplied with the CEA 035.

Order No. BU 007 654 -T



Carbon-Metal-Carbon evaporation attachment CGC 010

This attachment is designed for applying carbon-gold-carbon coatings or carbon-platinum-carbon coatings to SEM specimens according to Professor Blaschke's method without interrupting the vacuum.

Precoating the specimen with carbon allows the subsequent sputter layer to be thinner. The second carbon coating protects the sputter layer.

Consisting of:

- 1 Double carbon thread evaporator
- 1 Glass cylinder, ID 108 x 60 mm (BU 014 597)
- 1 Mounting device
- 2 High-current cables (BU 005 632 -T)
- 1 Spool of carbon thread (BU 007 161 -T)
- 1 Splinter shield with safety plug

The CEA 035 high-voltage power supply unit is needed in order to operate the CGC 010.

Order No. BU 007 196 -T



Carbon thread evaporation accessory CEA 035

For preparing conducting carbon coatings on SEM specimens for X-ray microanalysis (EDX, WDX).

For additional details on this method, please request our CED 030 Brochure (BU 800 189 PD)

Consisting of:

- 1 Single carbon thread evaporation flange (BU 007 654 -T)
- 1 Mounting bench for reducing the distance (BU 014 954)
- 1 CEA 035 high-voltage power supply
- 1 Glass chamber, ID 108 x 172 mm
- 2 High-voltage cables (BU 005 632 -T)
- 1 Spool of carbon thread (BU 007 161 -T)
- 1 Shatter guard with safety plug

Order No.

230 V / 50/60 Hz	BU 007 199 -T
115 V / 50/60 Hz	BU 007 399 -T



Multiple carbon thread evaporation flange

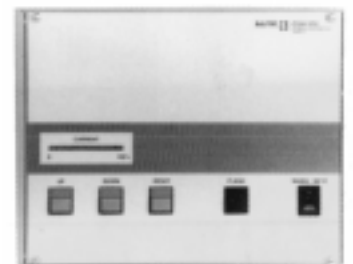
Consisting of:

- 2 High-current plug connections (BU 007 459 -T)
- 2 Quick-action clamps (BU 008 700 -U)
- 1 Rotating shutter

This flange is used instead of the single carbon thread evaporation flange (BU 007 654 -T) and makes it possible to evaporate carbon threads a maximum of three times without interrupting the vacuum.

Needed to achieve thicker carbon layers.

Order No. BU 007 653-T



CEA 035 high-current power supply unit

For supplying power to and controlling the single and multiple carbon thread evaporator and the CGC 010.

(Included in a CEA 035 carbon thread evaporation accessory shipment).

Order No.

230 V / 50/60 Hz	BU G05 250
115 V / 50/60 Hz	BU G05 251



QSG 060 quartz crystal film thickness measurement device

For measuring the thickness of sputtered or evaporated layers and for displaying the coating rate.

Consisting of:

- 1 QSG 060 quartz crystal film thickness measuring device
- 1 QSK 060 quartz crystal head
- 1 Quartz crystal head mount
- 1 Oscillator
- 1 Set of connecting cables
- 1 Set of quartz crystals (10 each)
- 1 Bench unit casing

Order No.

230 V / 50/60 Hz	BU 017 217 -T
115 V / 50/60 Hz	BU 017 117 -T

Mechanical spare parts for SCD 005

For approximately 2 years of operation

Consisting of:

- 2 Glass vacuum chamber
- 6 Gaskets
- 1 TPR 010 pirani vacuum gauge
- 1 P 3 rotary pump oil (5 L)
- 1 Gas metering valve
- 1 Gas pressure damping element
- 1 Target holder ring
- 1 Anode ring

Order No. BU 007 390 -T

Specimen preparation stage

An universal stage in which all conventional specimen mounts can be held while mounting specimens. Made of anodized aluminum.

Order Nr. BU 014 016-T

Consumables

Carbon threads

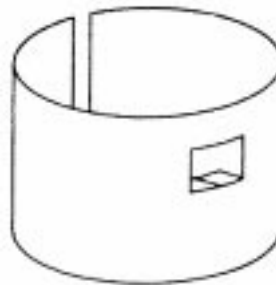
Spool with 3.5 m

Order No. BU 007 161 -T

Quick-change foil targets

Foil targets, diameter 54 mm x 0.2 mm.
(not included in basic equipment).

Target material	Order No.
Gold	B 8010 072 21
Gold/palladium	B 8010 072 29
Silver	B 8010 072 26
Platinum	B 8010 072 28



Coating protection foil

For glass chamber, ID 108 x 106 mm.
Prevents coating of the glass chamber by sputtering.

10 ea. per package

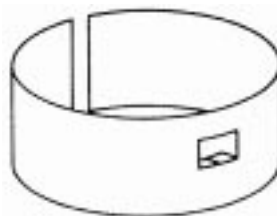
Order No. BU 007 389 -T

Coating protectino foil

For glass chamber ID 108 x 172 mm

10 ea. per package

Order No. BU 007 388 -T

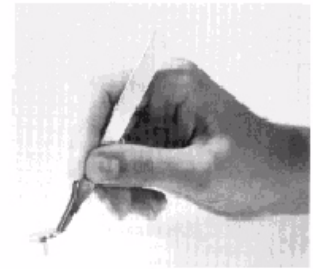


Coating protection foil

For special chamber DN 205.
Prevents coating of the glass chamber by sputtering.

10 ea. per package

Order No. BU 007 393 -T



Special tweezers

For secure pick-up and holding of SEM specimen stubs for Cambridge, Etec, Philips and Zeiss microscopes.

Order No. B 8010 030 11



Silver conducting paint

For making conducting layers and for fixing SEM specimens on specimen mounts.

Quick drying.

Bottle with 15 ml of paint.

Order No. B 8010 140 20

Nickel conducting paint

For making conducting layers and for fixing SEM specimens on specimen mounts.

Quick drying.

Bottle with 60 ml of paint.

Order No. B 8010 140 21

Solvent

For silver and nickel conducting paints. Also for cleaning specimen mounts. Not for use as a thinner for conducting paints because of danger of conductivity loss.

Bottle of 30 ml of solvent.

Order No. B 8010 140 98

Hydro-Collag

Conductive carbon glue for SEM specimens.

Bottle of 50 ml of glue.

Order No. BU 014 095-T

Leit-C (after Göcke)

Leit-C has good adhesive properties. Since it is also electrically conductive, inherently conductive specimens can be observed in the SEM immediately after mounting the stub and drying of the solvent. Once non-conducting specimens fixed to the mount with Leit-C have been coated with carbon or metal, no extra measures such as the installation of jumpers are required. As a result of its composition, no signal other than the normal background noise due to Radiation (due to retarding of particles) arises from Leit-C during energy dispersive X-ray analysis.

30 g package

Order No. B 8010 140 75

Thinner for Leit-C

One package of thinner is needed for every three packages of Leit-C.
30 ml package.

Order No. B 8010 140 76

Leit-C-Plast

Leit-C-Plast is a special adhesive plasticine for preparing larger specimens for the SEM.

Its properties:

- High electrical conductivity
- High vacuum-proof
- Sufficiently adhesive
- Negligible contamination of specimens
- No spurious ED X-ray lines
- Two plastic sheets for rolling out included

15 ml package

Order No. B 8010 140 77

Tempfix

A temperature dependent adhesive for powdered specimens and small parts for scanning electron microscopy. Tempfix produces smooth surfaces so that even the smallest objects can be observed at high magnification in the SEM without interference from disturbing background structures. Complete Tempfix kit, consisting of resin and four aluminum platelets with one specimen mount.
Enough for about 50 preparations.

Order No. B 8010 140 78

3 M double-side adhesive tape

For fixing SEM specimens to the mount.
With protective backing.
Width 12,7 mm, length 33 m.

Order No. B 8010 140 23

Photo-Fix corners

For sticking to the specimen mount. Both sides adhesive so that granulated or powdered specimens dusted into these corners are held firmly.
Dispenser box with 200 corners.

Order Nr. B 8010 140 96

Conductive aluminum adhesive tape

Thin aluminum tape with conductive glue. As base for SEM specimens. Gives smooth, conducting surface.
Width 6,4 mm, length approx. 55 m.

Order No. B 8010 140 24

Conductive copper adhesive tape

Thin copper tape with conductive glue as base for SEM-Specimens. Give smooth, conducting surface.
Width 6.4 mm, length approx. 55 m.

Order No. B 8010 140 25

3 M transfer tape

Very thin, transparent, double-sided adhesive tape with protective paper backing. For fixing fine grained material, thin films, etc. to SEM specimen mounts.

Width 12,7 mm, length approx. 55 m.

Order No. B 8010 140 26

**Scotch-Brite cleaning cloths**

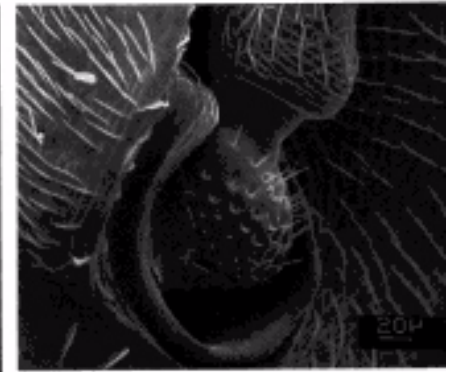
For mechanical removal of coated film from glass or metal surfaces.
Package of 5 pieces.

Order Nr. BU 017 029-T

Bibliography

- [1] W.R. Colquhoun
Sputter Shadowing Device and Process
BAL-TEC Technical Report
BU 800 110 DE (8606)

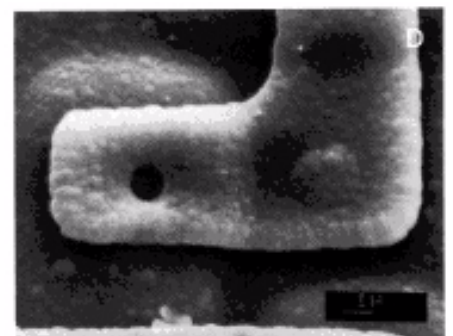
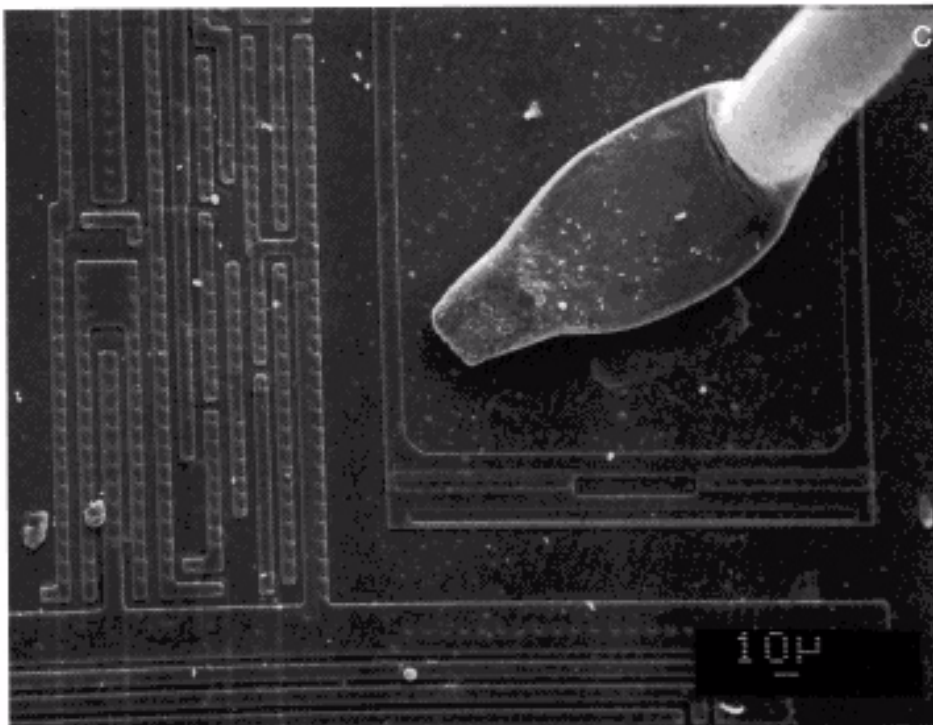
Results



A: Head of an ant Mag.= 40 x

B: Detail of a feeler joint Mag.=400 x

Sputtered on film: 30 nm Au

Photos: EM-Applications Laboratory,
BAL-TEC AGC: E-chip with bonding plate
Mag.= 300 xD: Detail of interconnection
Mag.=8000 x

Sputtered on film: 20 nm Au

Photos: EM-Applications Laboratory,
BAL-TEC AG