BAL-TEC SCD 005

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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 preselected 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. Colquhuon [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 an 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.

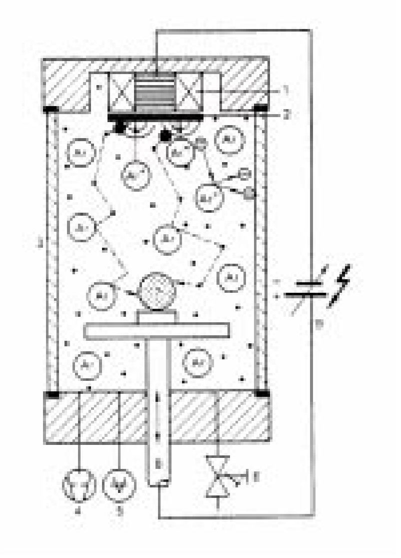
Because of the high surface diffusion of their atoms, gold and silver tend to form “islands“. Thus the desired electrical conductivity is not achieved until the film is at least 10 nm thick. Platinum produces films with the finest grains.

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

Ⓐ Argon atoms
⊖ Electrons
Ⓐ 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.

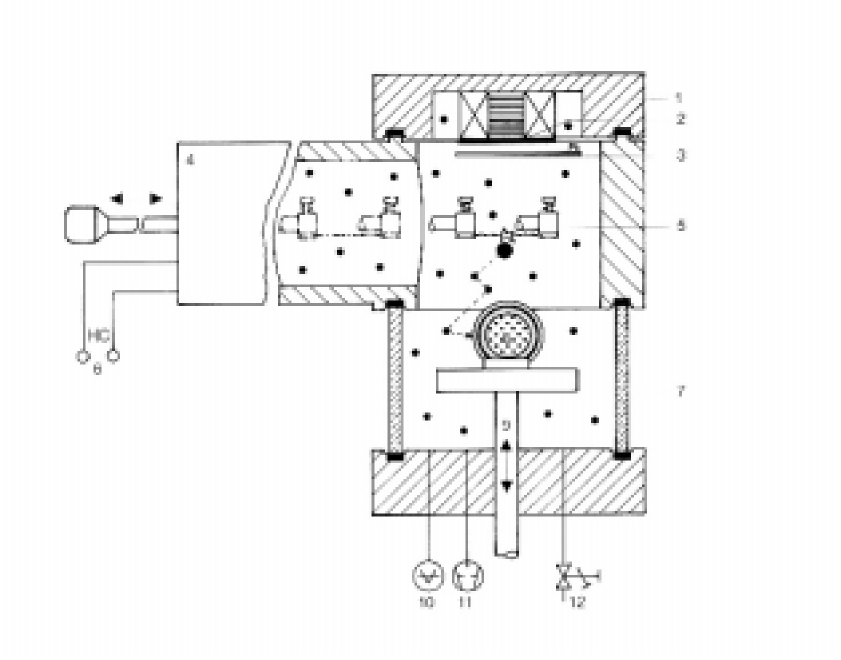
The Carbon-Metal-Carbon Evaporation Method

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 standardsputtering 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. Colquhuon, 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	54 mm
	Thickness	0,2mm
Working distance	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 x 10^{-2} mbar with a two stage rotary vane pump, pumping speed 5 m^3/h, and a 1.5 m long vacuum hose	approx. 2 min.

Roughing pump

Two stage rotary vane vacuum pump 5 m^3/h

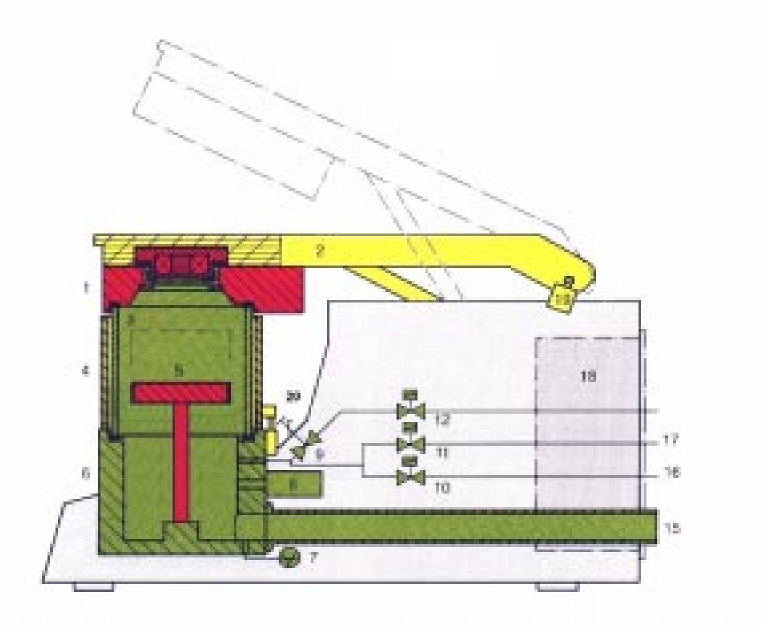
Pumping speed at 50 Hz	5.4 m^3/h
Pumping speed at 60 Hz	3.8 cfm
Ultimate total pressure without gas ballast	< 2 x 10^{-3} mbar
Max. power consumption at operating temperature	450 / 550 VA
Weight	25 kg

Alternative 1

Two stage rotary vane vacuum pump 10 m^3/h

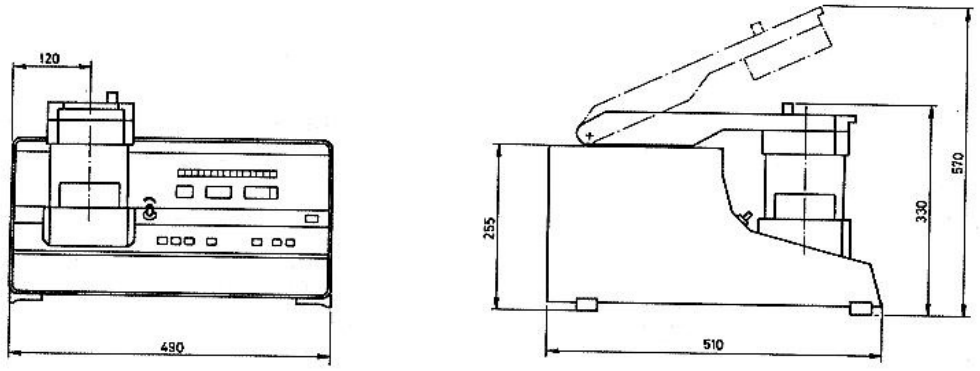
Pumping speed at 50 Hz	9.7 m^3/h
Pumping speed az60 Hz	6.8 cfm
Ultimate total pressure without gas ballast	< 2 x 10^{-3} mbar
Max. power consumption at operating temperature	450 / 550 VA
Weight	26 kg

Design

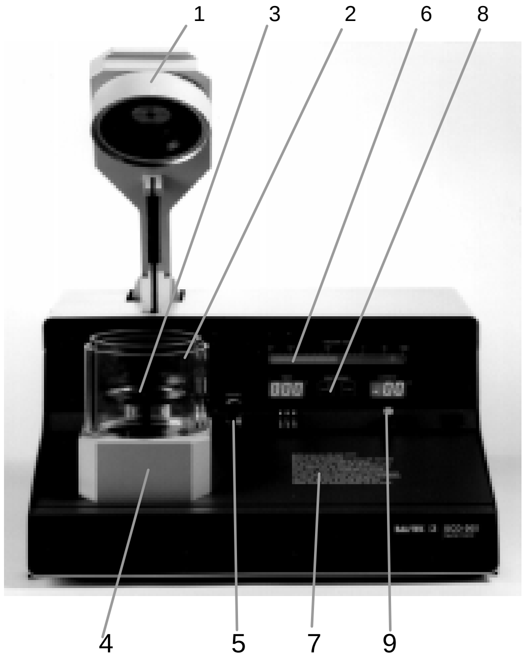


1	Target head with magnet system
2	Hinged arm with piston damper
3	Glass vacuum chamber
4	Splinter shield
5	Height-adjustable specimen table
6	Vacuum chamber base
7	Medium vacuum gauge
8	Vacuum switch
9	Gas dosing valve (manual)
10	Automatic venting valve
11	Rinsing gas valve
12	Automatic gas supply 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 wiew 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