Specimen Coating for High Resolution Electron Microscopy

Phil Missing, Emitech, Ltd.

Probably the most common coating technique in electron microscopy is sputter coating, primarily for SEM where a thin electrically conducting film is required to prevent charging and to enhance secondary electron emission.

These systems are relatively inexpensive, and the modern instruments are easy to use, often being fully automated.

D.C. Sputtering

The direct current (dc) sputter coater uses the arrangement of two electrodes. One positive - the specimen stage, and one negative - the target, typically gold. A glow discharge is formed, and the sputtered material from the target is deposited onto the specimen.

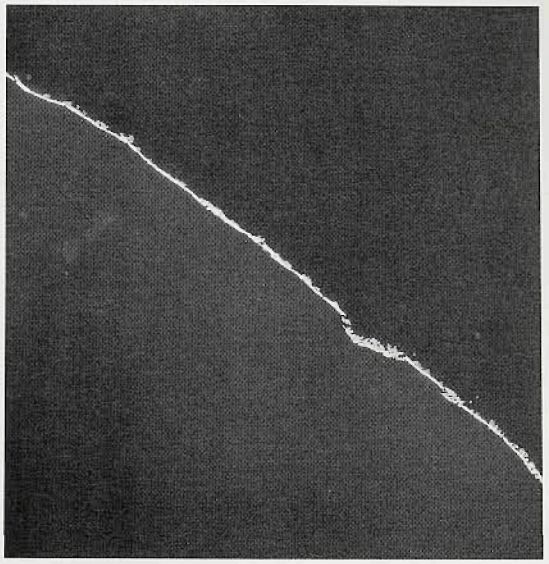
The sputtering efficiency is often enhanced by the use of a magnetron head. An inert gas such as Argon is used, and a suitable low pressure is achieved using a two stage rotary vacuum pump. The grain size for gold target material is of the order of 2 - 5 nm. To achieve a continuous film, the thickness of deposition is typically 10 nm but may be somewhat thicker, up to 20 nm for an irregular specimen.

Chromium Deposition

With a turbo sputtering system it is now possible to sputter chromium and achieve fine grain size of order of 0.5 nm thick - which is electrically conductive and continuous. This development in sputter coaters provides ultra thin, high quality films for the users of high resolution SEM.

Until recently, these coatings have been suitable for most SEM applications. With the advent of high resolution SEM, in particular field emission, there is an increasing requirement to improve the performance of the coatings to smaller, continuous films.

While ion beam systems are being employed, the deposition times are long and the instrumentation is relatively expensive.



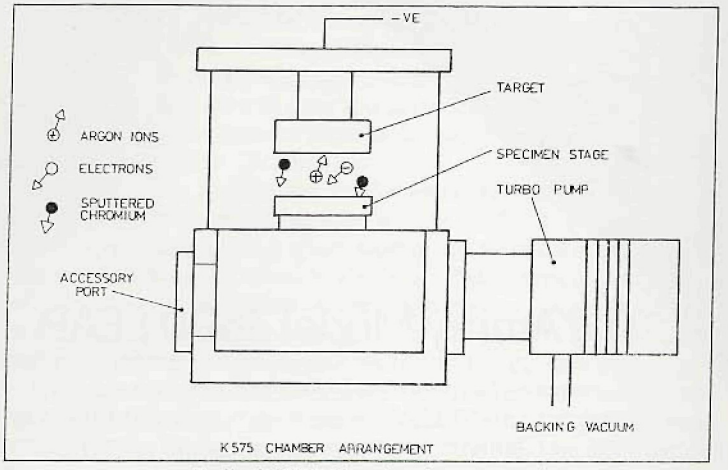
Ultra Thin Continuous Chromium Film

Turbo Sputtering

There are benefits in depositing ultra thin films of chromium on SEM specimens to give improved resolutions at higher magnifications.

To avoid the formation of oxide and contamination when using chromium as the target material, it is necessary to operate at pressures lower than those achievable using two stage rotary vacuum pumps. Such systems usually employ a turbomolecular pumping system.

The system is pumped down to 1 x 10^{-5} mbar. Using an argon bleed, sputtering is typically at 1 x 10^{-2} mbar. ■

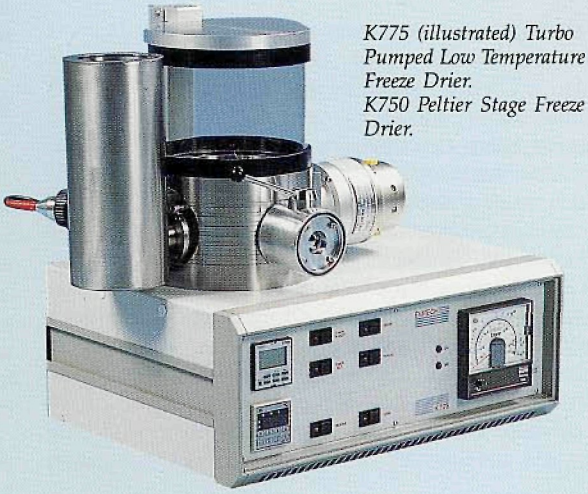


Emitech K575 Chamber Arrangement

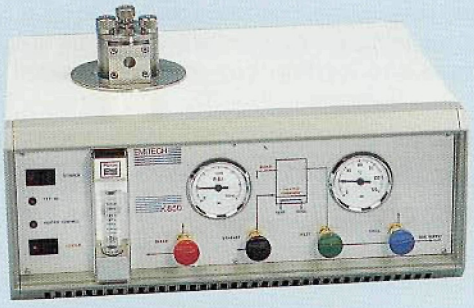
EMITECH K SERIES

THE COMPLETE 'SPECTRUM' OF PREPARATION EQUIPMENT

K575 (illustrated) Turbo Pumped Sputter Coater for Chromium.
K550 Sputter Coater for Gold.
K650 Large Sample Sputter Coater.

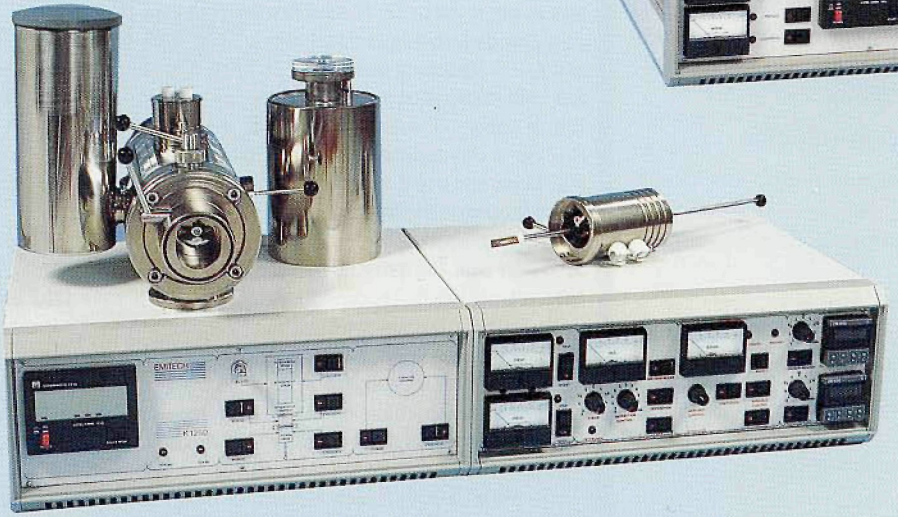


K775 (illustrated) Turbo Pumped Low Temperature Freeze Drier.
K750 Peltier Stage Freeze Drier.



K850 Critical Point Drier.

K975 (illustrated) Turbo Pumped Evaporator System.
K950 Turbo Pumped Carbon Evaporator.
K450 Carbon Fibre Coater.



K1250 Cryogenic System with Integral Turbo Pumping, and Interfacing to S.E.M.

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