Electron beam evaporator

BESTEC

PRINCIPLE

In the evaporation process, vapors are produced from a material located in a source (positively charged anode) which is heated by electron beam (given off by a charged tungsten filament). The process is carried out in high vacuum (10^{-7} to 10^{-8} mbar) so that the evaporated atoms undergo an essentially collisionless line-of-sight transport prior to condensation on the substrate. The substrate is usually at ground potential (i.e., not biased).

Although E-Beam Evaporation is used in a wide variety of applications, it is particularly efficient in transferring pure and precise metal coatings that require high melting temperatures to substrates on the atomic and molecular level.

Several different layers of coating from different target materials can be applied with a multiple crucible E-Beam evaporator without breaking the vacuum making it adapt easily to a variety of lift-off masking techniques.

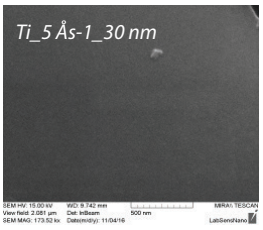
Electron beam gun

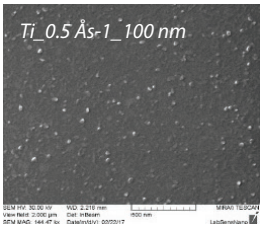
The impact of a high energy electron beam into a metallic sample offers a clean and high energy density method of heating (compared to resistive and inductive type of evaporators). In the electron gun, the alectron are produced by hot electron emission from a tungsten cathode (thermionic gun) and are formed to a beam. At the impact point of the sample, most of the electron energy is given up as heat. Thermionic guns have the limitation of a minimum operating gas pressure of about 1.3×10^{-3} mbar [1].

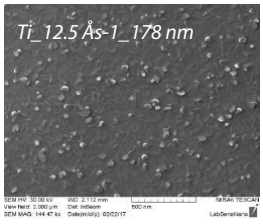
RESULTS

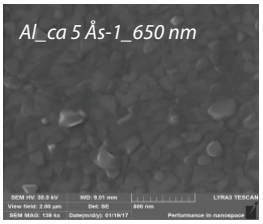
Thin film microstructure depends on:

- nature of the substrate
- temperature of the sub strate during deposition (heating up the substrate increases the incident atom mobility and the step coverage of the coating)
- rate of deposition
- deposit thickness
- angle of incident of the vapor stream
- pressure and nature of the ambient gas phase [1]









SEM micrographs of some test depositions made by the e-beam evaporator at the room temperature and different deposition rates (the chamber pressure might vary as well). The deposit thickness is a more crucial parameter than the deposition rate - proven only on Ti layers.

MORE INFO

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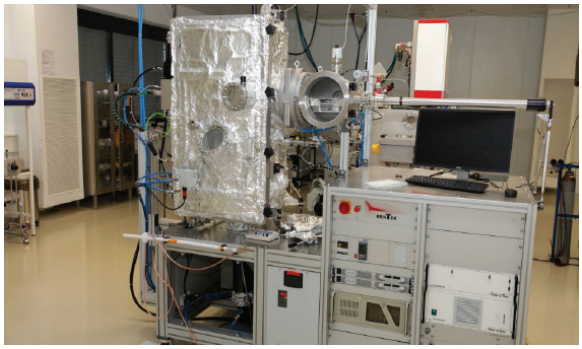


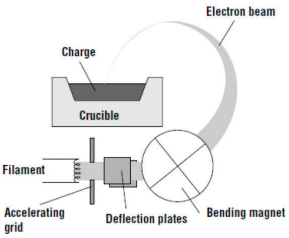
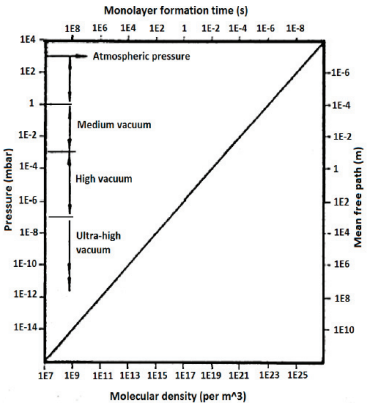


Fig. A popular e-beam evaporative source using a strong magnetic field which bends the beam through 270°. The beam can be rastered across the material to melt a significant fraction of the surface [2].



Values of molecular density, mean free path and time to form a monolayer, as a function of pres-sure, for air at 25°C [3] (1 mbar = 100 Pa).

SPECIFICATION

Accelerating voltage	up to 10 kV
Power source	up to 10 kW
Sample size	7×7"
Substrate temp	RT–900 °C
Standard deposition materials	Au, Ag, Ti, Cr, Cr_2O_3, Co, Al, Cu, Ni, Fe, CrNi, NiFe

PUBLICATIONS

[1] R.F. Bushah: Handbook of Deposition Technologies for Films and Coatings, Noyes Publication, New Jersey, 1994
[2] S.A. Campbell: Fabrication Engineering at the Micro– and Nanoscale, Oxford University Press, Oxford, 2008
[3] N.S. Harris: Modern Vacuum Practice, McGraw-Hill, London, 1989