Design and Characterization of a High Vacuum Metals Deposition System based on Electron Beam Evaporation

A. Ramírez-Porras, E. Avendaño-Soto, J. Araya-Pochet

Centro de Investigación en Ciencia e Ingeniería de Materiales (CICIMA)

Escuela de Física, Universidad de Costa Rica, San Pedro 2060

COSTA RICA

Abstract

We describe a *high vacuum metals deposition system* based on a variation of a pendant-drop type electron beam evaporator. This system uses *a Molybdenum crucible* as an evaporant instead of a rod or wire usually used in ultrathin films growing systems. The advantage of this setup is that it can evaporate different metals with a power delivered to the crucible of around *100 W* in optimum operation mode. X-Rays fluorescence test performed on the so-obtained thin films show no crucible material contamination traces, a very important point in surface science technology.

System Specifications

Vacuum pumping:

•Varian SD-450 mechanical pump.

•Varian Turbo V-250 turbomolecular pump.

Pressure measurement:

•Ion gauge coupled to a Granville-Phillips 270 controller.

Evaporation method:

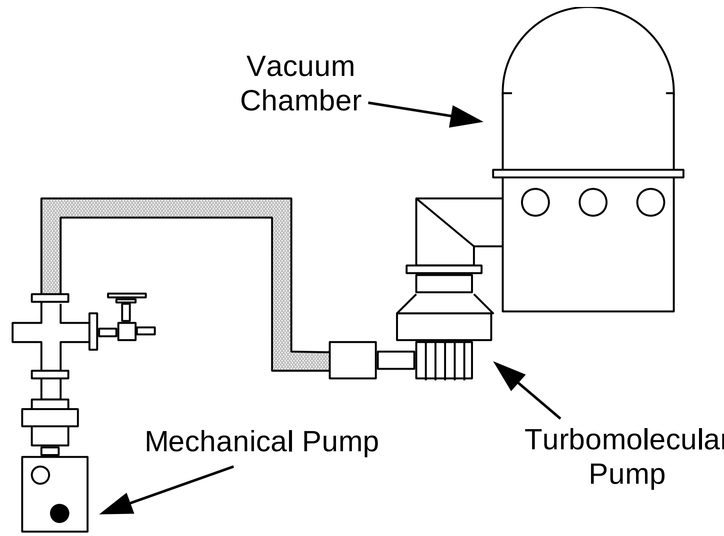
• Electron beam gun based on a Molybdenum crucible and negative biased Tungsten filament.

Target:

•Glass or mylar, 2 x 2 cm area.

Film thickness measurement:

•Quartz crystal with gold contacts, 6 MHz oscillation frequency coupled to a Maxtek TM-200 monitor.



Accelerating voltage: 1.5 to 2 kVolts.

Filament current: 10 Amps.

Max. Emission current: 0.6 to 0.8 Amps.

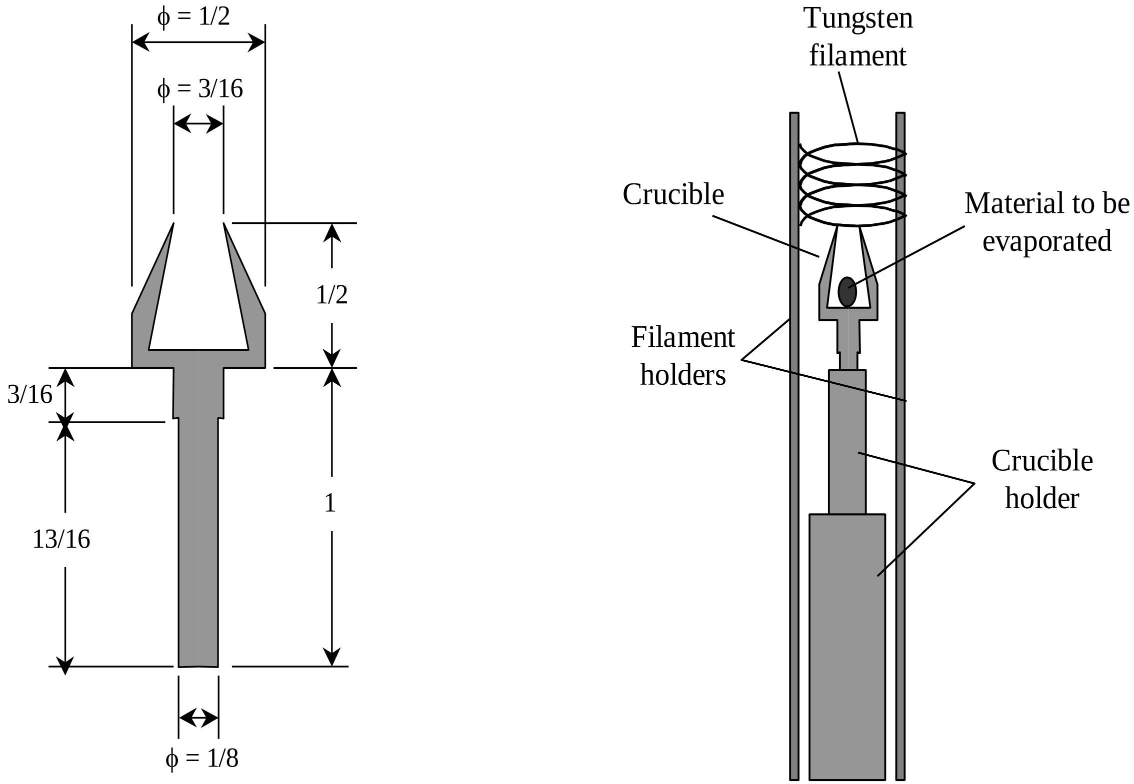


Figure 1. (a) Crucible transversal section. Some of their dimensions, expressed in inches, are also showed. (b) Crucible already attached to the electron beam gun system. The Tungsten filament provides the electrons necessary to heat the crucible up and to start the evaporation process.

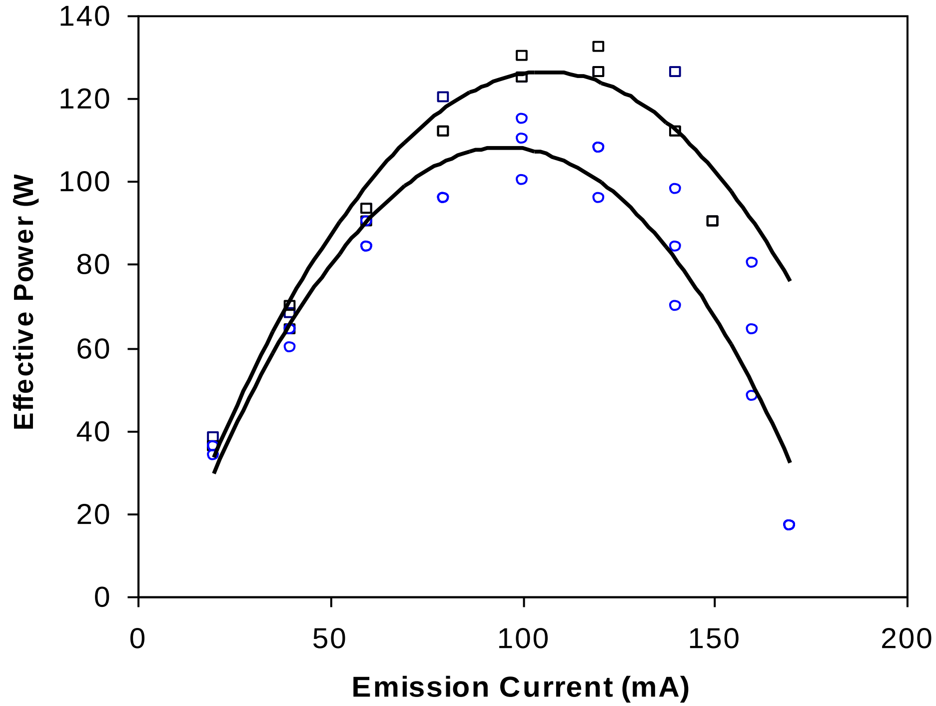


Figure 2. Obtained evaporation power as a function of emission current for two typical runs. The solid curves represent best fits..

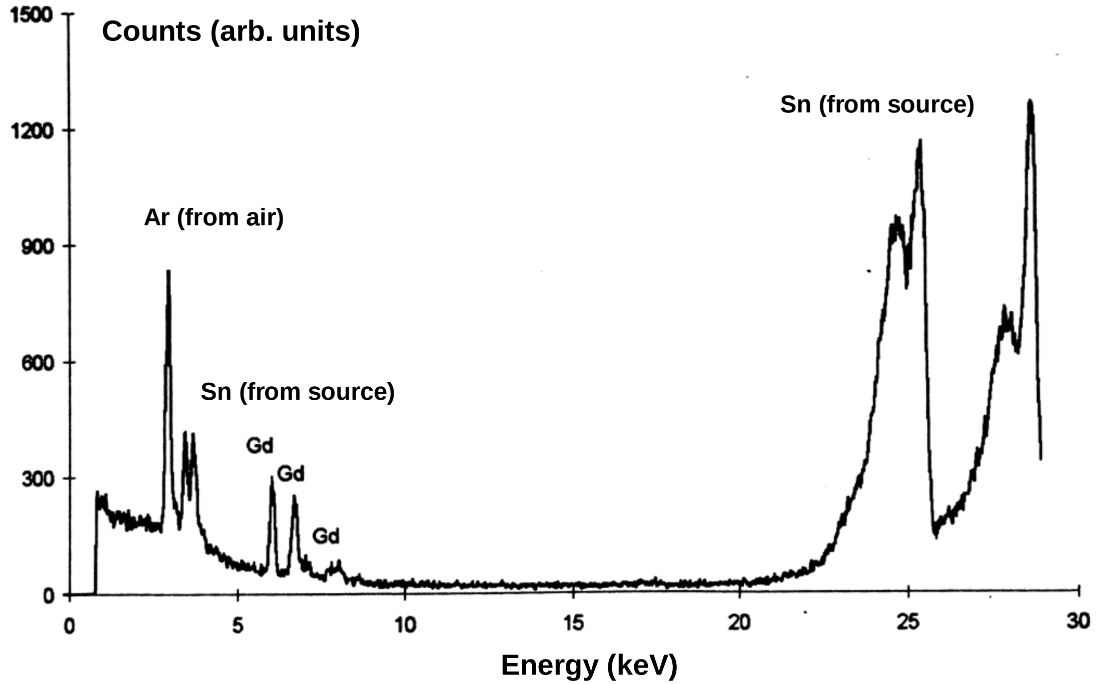


Figure 3. X-Rays fluorescence spectrum of a Gadolinium-on-Mylar film using a Molybdenum crucible. No traces of contamination are visible.

Conclusion

The system based on electron bombardment shows good performance in the production of thin metallic films even for a relatively low power yield of 100 W, with no traces of crucible contamination. Also, the crucible design allows the system to work with metals with high or low melting points.

Aknowledgements

- **Prof. Alfonso Salazar Matarrita, Laboratorio de Física Nuclear Aplicada (LAFNA), Universidad de Costa Rica.**
- **Vicerrectoría de Investigación, Universidad de Costa Rica.**

References

J. Araya-Pochet, G. A. Mulhollan, and J. L. Erskine, "A simple substitute for Knudsen cells using an existing pendant-drop type electron beam evaporator". ***Rev. Sci. Instrum.*****, 62 (1991) p. 2288.**