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THIN FILM DEPOSITION LAB

DENTON VACUUM EXPLORER™ EVAPORATOR

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Denton Vacuum Explorer™ evaporator system has both thermal and electron beam evaporation sources. There is a single mass flow controller (MFC) that is currently used for reactive deposition of oxides. The chamber can be heated up to 150 °C. In addition, the system can accommodate substrates up to 6” in diameter; hence, it keeps the space of accommodating various substrate sizes as per application needs.

Generally, the thermal evaporation process using direct resistive heating is one of the simplest forms of evaporating a material for thin-film deposition. A low-voltage, high-current power supply forces an electrical current through a conductor in contact with the desired source. For e-beam evaporation, fixed high-voltage, low-current power supply forces an e-beam in contact with the desired source. Additionally, it is possible to deposit materials that cannot be evaporated with standard resistive thermal evaporation. An additional benefit of e-beam evaporation is higher deposition rates than possible with either sputtering or resistive evaporation.

As aforementioned, such technique consists of heating until evaporation of the material to be deposited. The material vapor finally condenses in form of thin film on the cold substrate surface and on the vacuum chamber walls. Usually low pressures are used, about 10-6 or 10-5 Torr, to avoid reaction between the vapor and atmosphere. At these low pressures, the mean free path of vapor atoms is the same order as the vacuum chamber dimensions, so these particles travel in straight lines from the evaporation source towards the substrate. This originates 'shadowing' phenomena with 3D objects, especially in those regions not directly accessible from the evaporation source (crucible). Besides, in thermal evaporation techniques the average energy of vapor atoms reaching the substrate surface is generally low (order of kT, i.e. tenths of eV). This affects seriously the morphology of the films, often resulting in a porous and little adherent material. Before developing any recipe, we calibrate the tool to measure the expected film thickness. Such calibration follows an iteration process before growing the requested films through tuning tooling factor and thickness measurement using Dektak profilometer. This enables us to provide the right service to the customers through homogeneous, right thickness, compact, and pin holes free layers.

Our installed E-beam evaporation is useful to deposit a wide variety of materials. Commonly used for such optical thin film applications as optical filters and solar panels, e-beam evaporation provides the optical, electrical, and mechanical qualities required. Also, it provides a high material utilization efficiency compared to other PVD processes and results in reduced costs. The internal overview of our system has been shown below.

TECHNICAL SPECIFICATIONS

- Thermal & e-beam evaporation
- Base vacuum in the 10-7 to ultra-high vacuum scale
- Maximum 6” substrate size with the option of loading various substrate sizes below 6”
- 1500 ºC heating capability
- 4 e-beam evaporator pockets to allow deposition of stacked films without breaking the vacuum
- One mass flow controller (MFC)

CAPABILITIES

- Optical film design
- Photovoltaic & advanced materials research
- Advanced electron microscope sample preparation
- Semiconductor device development

PICTURES OF EQUIPMENT

Denton Explorer™ evaporator system