Training protocol on ebeam deposition AJA system

* Duration: 1-2 hours per session
* Location: FAB 1

Electron Beam (E-beam) Deposition is a physical vapor deposition (PVD) technique used to deposit thin films of materials onto substrates. In this process, a high-energy electron beam is used to heat and vaporize the source material inside a vacuum chamber. The evaporated atoms or molecules then travel through the vacuum and condense on the substrate, forming a thin film. E-beam deposition is widely used for creating thin coatings of metals, dielectrics, and semiconductors with precise control over thickness and composition.

How E-beam Deposition Works:

1. High Vacuum Chamber: The deposition process takes place in a vacuum chamber to reduce contamination and ensure that the vaporized material reaches the substrate without colliding with gas molecules.
2. Electron Beam Source: A high-energy electron beam is generated using an electron gun, which focuses and directs the beam towards the target material (source). The electron beam heats the target material, causing it to melt and vaporize.
3. Material Vaporization: As the electron beam heats the material, atoms or molecules of the target material are ejected as vapor. This vapor travels through the vacuum chamber and moves toward the substrate.
4. Thin Film Formation: The vaporized atoms condense onto the surface of the substrate, forming a thin, uniform film. The thickness of the film is controlled by adjusting the deposition time, the power of the electron beam, and the rate of material vaporization.

Key Features of E-beam Deposition:

* Versatility: E-beam deposition can be used to deposit a wide range of materials, including metals, semiconductors, and insulators. It is particularly well-suited for high-melting-point materials, such as tungsten, tantalum, and ceramics, which are difficult to evaporate using other methods.
* High Deposition Rates: Compared to other techniques like atomic layer deposition (ALD), E-beam deposition allows for relatively high deposition rates, making it more efficient for creating thicker films.

Applications:

* Optical Coatings: E-beam deposition is used to create thin films for anti-reflective coatings, mirrors, and other optical devices.
* Semiconductor Fabrication: It is used for depositing metal contacts, interconnects, and dielectric layers in microelectronics.
* Decorative and Protective Coatings: Thin films of metals or alloys are deposited for both aesthetic finishes and protective layers against wear and corrosion.

Limitations:

* Line-of-Sight Deposition: Because the material vaporizes in a straight line, it is difficult to achieve uniform coatings on surfaces with complex shapes or deep trenches.
* Up to 6” wafer

Session Topics

1. Introduction to basic principles of ebeam evaporation
2. Machine Components Overview
   * Description of the main components
   * Understanding vacuum systems and their role in sputtering.
3. Safety Protocols
   * Overview of safety guidelines and personal protective equipment (PPE).
   * Emergency shutoff and fire safety procedures.
   * Safe handling of materials and equipment.
4. Setting up the system
   * Step-by-step instructions on machine startup.
   * Explanation of substrate loading
5. Operating the Machine
   * Monitoring deposition parameters: pressure, power, and rate.
   * Process timing and control.
6. Film Deposition Process
   * Thickness control and uniformity.
   * Deposition rates and optimization techniques.

Hands-On Practice

* Machine Setup: Participants practice setting up the AJA machine.

Notes:

* Don’t start deposition if cryo temp. is above 15K
* After deposition of SiO2, user must deposit 10-20 nm Ti