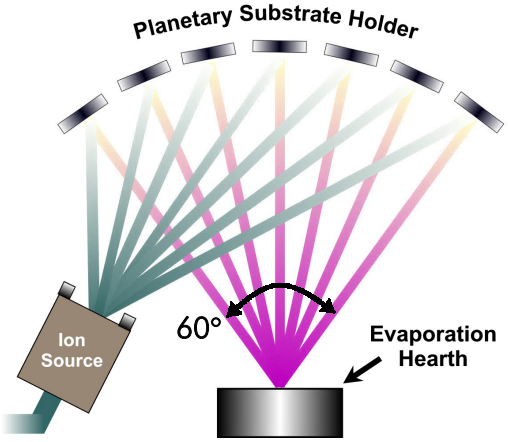
Gridless Ion Source Technology and Applications

Gridless End-Hall Technology

Veeco's End-Hall ion sources provide a broad beam half-angle of 30° producing uniform ion densities over a large substrate plane. The low energy, high-current operation results in superior ion flux for improved thin film properties.



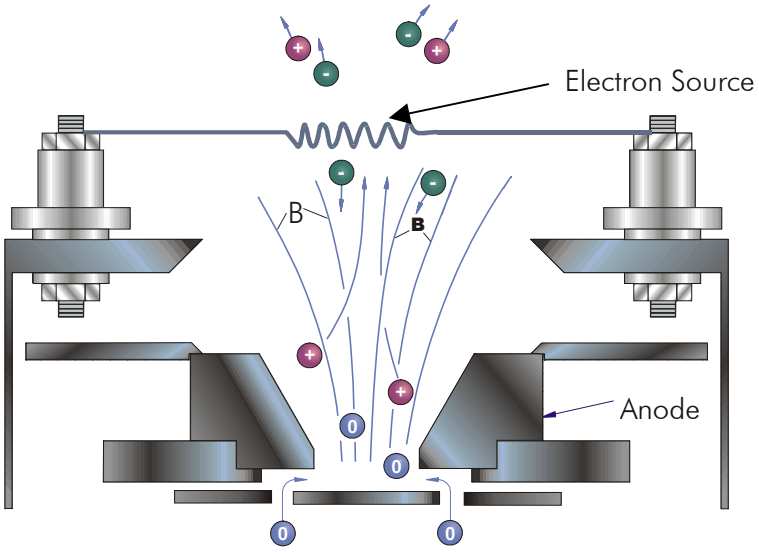
Typical End-Hall Configuration

Features

- High vacuum compatibility
- Rugged and reliable design
- No grids to align
- Production proven
- Reactive gas compatible
- Reproducible beam characteristics
- Effortless and inexpensive maintenance
- Easy Installation
- Retrofittable into virtually any vacuum chamber

End-Hall ion sources are well suited to applications where large currents of low-energy ions are utilized to assist thin film deposition. This process increases adhesion, modifies stress, increases density and hardness, produces a preferred orientation and improves step coverage. Additional process benefits include the ability to:

- Lower deposition temperature
- Maintain low background pressures ($<1 \times 10^{-4}$ Torr)
- Eliminate substrate biasing
- Provide run-to-run repeatability



Gridless End-Hall ion sources provide an accelerating potential using both magnetic and electrical fields. The gridless design enables the source to generate high currents (up to 5A), low energy beam for wide area coverage.

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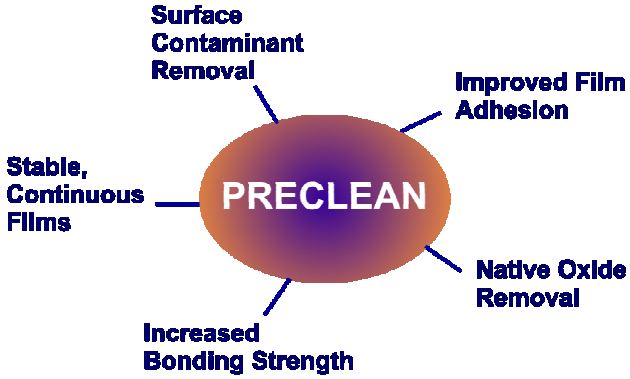
Ion Beam Precleaning

Low energy ion cleaning prior to deposition increases bond strength and improves surface properties such as film/substrate adhesion.

Ion beam precleaning removes surface contaminants such as water vapor, hydrocarbons, native oxides and other absorbed materials. If left intact, these contaminants can lead to shifts in the index of refraction, film property instability, and peeling or flaking of the film.

Veeco's End-Hall ion sources inherently use low-energy ions. Therefore, risk of surface penetration or resulting damage to the substrate is eliminated.

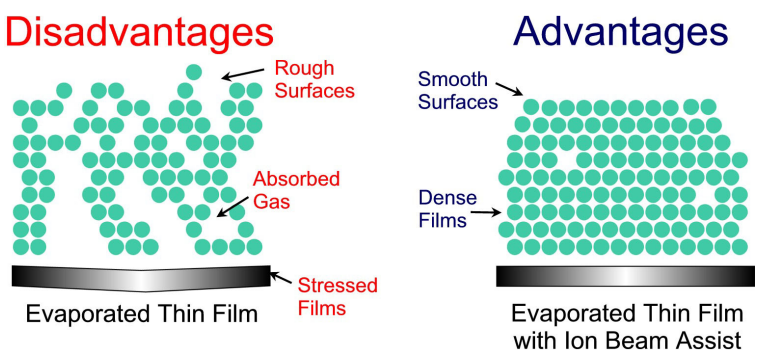


Ion-Assisted Deposition

Thin film properties are improved with ion bombardment of the substrate surface during deposition. Energetic ion beams assist initial film growth by activating the grain boundary, thus promoting "island destabilization".

This technique has been shown to improve step coverage, modify film stress, increase packing density, reduce absorbed residual gas contaminants and improve film adhesion and hardness. Also, by minimizing pinholes, environmental film stability is assured.

Computer Model of Deposited Films



An ion beam can reduce the stress for a vapor-deposited film. This permits thicker films to be deposited without sacrificing adhesion, by utilizing the ion energy instead of conventional heating techniques.

- Control of stoichiometry
- Control of stress
- Improved film growth
- Preferred film structure
- Reproducible results
- Low substrate temperatures

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Optical Coatings

Today's optical thin-film designs require low-absorption, mechanical and environmental durability and consistently stable properties such as dense films, low residual stress and preferred crystal orientation. Veeco's End-Hall ion sources meet these needs and render them ideal for high-quality optical coating requirements.

Because of their low temperature deposition capabilities, coatings currently deposited at high temperatures can now be coated without the addition of heat using a Veeco End-Hall ion source. Using the End-Hall for temperature sensitive substrate processing significantly improves throughput in existing systems and lowers the cost of new equipment. Temperature sensitive substrates such as plastics, polyesters and acrylics as well as unheated glass substrates all benefit from utilizing the End-Hall ion source for optical coatings.

Metal Coatings

Utilizing a Veeco End-Hall ion source for assisting metal deposition, the film can achieve lower resistivity and higher conductivity. Initially assisting the growth of the film can dramatically affect film performance, whether that be adhesion, reflectivity or electrical conductivity.

Substrate precleaning provides:

- Adhesion/bonding strength
- Improved film coalescence
- Change in surface morphology
  - Smooth/high reflectivity or
  - Roughing/texturing of surfaces
- Conversion of metallic thin films to insulating films with active gases
- Dense metal thin films to enhance hardness

Diamond-like Carbon (DLC) Coatings

Electrically Conductive and Electron-Emissive Carbon-Based Films

Operating with methane, the End-Hall source is capable of depositing a-C (amorphous carbon) type DLC, similar to the a-C:H DLC deposited by gridded DC and RF ion sources. With the broad distribution of ion energy, End Hall sources can produce DLC with:

- High mechanical hardness (up to 24 GPa)
- Chemical inertness
- High deposition rates of up to 700 D/minute

Applications

- Ion beam precleaning
- Anti-reflective coatings
- Ophthalmic coatings
- High reflection mirrors
- Beam splitters
- Hot/cold mirrors
- Low shift filters
- Band pass filters
- Insulating thin films
- Night vision optics
- Direct deposition of Diamond-like Carbon (DLC)

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