The ONYX- Revolution

Angstrom Sciences- Cylindrical Magnetrons
BACKGROUND

 Business for over 20 years
 Numerous US Patents including
  □ Profiled Magnets
  □ Turbulent water flow
 Complete Cylindrical Cathodes
  □ TCO, Reactive, and Metal Applications

For more info . . .
www.angstromsciences.com
TEAM RESOURCES

- 37 Employees
- 8 Engineering Staff
- 10 CNC Machinists
- On-Site Manufacturing
- In-House R&D Laboratory

Angstrom Sciences
THE SOLUTION: ONYX-REVOLUTION

- 85% or greater target utilization
  - Longer run times
- Narrow Vapor Flux
  - Clean and efficient sputtering
- Average 20% Power Savings
  - Operates at lower power level
The Solution Onyx-Revolution

- Advanced profiled Magnetic Design for optimal utilization and uniformity
- Gas Integration Options
  - Argon and Reactive gas inputs
- DC, Pulsed DC and MF Power
- Vertical and Horizontal mounting options
- Anode assembly is available
  - Can accommodate existing system layout
- Recommendation for Optimal Uniformity
  - Magnet bar length: 6” overhang on each side of substrate
  - 2”-4” source to substrate

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ONYX-REVOLUTION

*Magnetics:*
Profiled magnets naturally conform to the curvature of cylindrical target.
Rotating Cylindrical Magnetron Solutions:

Drop-In / Flange Mount Dual Rotatable. Vertical or Horizontal mounting.
Rotating Cylindrical Magnetron Solutions:

"Through the Wall"
Straight-thru cylindrical magnetron solutions. For vertical and horizontal applications.

Drive shaft custom sized to place target "centered" over substrate.

Target/Magnet Array length sized to customers substrate width.

Drive Block and target ends standard for all ASI "Straight-Thru" cylindrical magnetrons.
Rotating Cylindrical Magnetron Solutions:

Horizontal dual magnetron assembly (3m+) for flexible substrates.
Rotating Cylindrical Magnetron Solutions:
Cathode Drive Overview:
Cathode Drive Overview:

- Double Row Angular Bearings SKF 3211A
- Vacuum Seals (Primary and Back-Up)
- Power Buss (>400A Rating)
- Drive Rotation Sensor
- Water Seals (Primary and Back-Up)
- Magnet Array Alignment Key
- Water Inlet Chamber
- Water Outlet Chamber
Target Assembly Overview:

- KF63 Type Quick Clamp
- Axial Alignment Support
- Target Material
- Debris Shields (Electrically Floating)
Target Assembly Overview:

- Remove 4 Screws and Circ-Clip to Remove Debris Shields
- Magnet Support/Water Inlet Tube
- Magnet Array Assembly
- Static Water-Vacuum Seal
- Water IN
- Axial Support
- Water OUT
- Magnet Support Shaft Centering Bushing
- Debris Shield Electrical Isolation
Calculating Target Lifetime (Example)

Assumptions:
Non Reactive Process
Film Density = Target Density
1 Cathode Putting down film layer

Target OD
6.00” → 152.4 mm

Target ID (+.050”)
5.26” + .05 = 5.3 → 134.62 mm

Backing Tube
Calculating Target Lifetime (Example)

Available Target Material
(for Target Lifetime Calculation)

Vapor Flux Efficiency = 85%
Target Utilization = 85%

\[ \frac{\pi}{4} \times \text{Width} \times (\text{Target OD}^2 - \text{Target ID}^2) \times \text{VFE} \times \% \text{Util} \]

= \[0.785 \times 1 \times (152.4^2 - 134.62^2) \times 0.85 \times 0.85\]

= 2895 mm\(^3\)
Calculating Target Lifetime (Example)

Parameters Needed to Calculate Material Consumption Rate

Need Desired Film Thickness: (Example 1000 Ang.)

Need Linespeed: (Example 15 mm/sec)

Use same 1mm width for calculation
Calculating Target Lifetime (Example)

**Calculate Material Consumption Rate:**

Linespeed = 15 mm/sec  
Width = 1 mm

Thickness = 1000 Ang  
= 1 e-4 mm

Consumption Rate = Linespeed * Film Thickness * Width

= 15 * .0001 * 1 = \(0.0015 \text{ mm}^3/\text{sec}\)

**Calculate Target Lifetime:**

\[
Targ. \text{ Life} = \frac{\text{Material Available}}{\text{Consumption Rate}} = \frac{2895 \text{ mm}^3}{0.0015 \text{ mm}^3/\text{sec}}
\]

= 193000 sec --> 53.61 Hr.
Calculating Sputter Deposition Rate

Angstrom Sciences uses Dynamic Deposition Rate (DDR):

* Each target material/thin film has a unique DDR

Variables which can be calculated (user needs to know 5 of the 6 variables):

* Power requirement
* Number of cathodes required
* Projected Film Thickness
* Cathode Length
* Substrate Linespeed
* Material DDR
Angstrom Sciences Cylindrical Magnetron Arrays

2D Magnetic Field Modeling

[Image: Diagram of magnetic field model]
ANGSTROM ADVANTAGE: MODULAR MAGNET DESIGN

Magnet Assemblies have “interchangeable” turnaround designs that may be manufactured to your specific type of target.
More material is directed to the substrate, dramatically reducing build-up on shields and resulting in a cleaner and more stable process that requires less power to achieve a specific deposition rate!
ANGSTROM ADVANTAGE:
TIGHTER FLUX PROFILE

Static Deposition Profile for a Single Cylindrical Magnetron
(10.5 deg racetrack separation for ASI vs. 14.7 deg for a “typical” cylindrical magnetron)
Angstrom Sciences Cylindrical Magnetron Arrays

Normalized Deposition Profile For a Dual Rotatable Magnetron

ASI cylindrical racetrack separation of 10.5 degrees results in ~14% of material deposited on shields.

"Typical" conventional cylindrical racetrack separation of 14.7 degrees results in ~21% of material deposit on shields.
Angstrom Sciences Cylindrical Magnetron Arrays

3.5m Magnet Arrays for architectural Glass Coaters
Shim Placement on either (or both) sides of magnet array support to account for "tilt" in uniformity profile

Shim sizes:
0.015", 0.030", 0.060", 0.120"
Shims are used for small adjustments due to "local" effects which might be caused by gas flow, anode amplifications, ... Up to 5% changes can be made.

Shunts can be custom trimmed to length, placed anywhere along magnet array length, on 1 or 2 sides of the magnet pack, 1/2" height adjust.
ERODED TARGET: 85%+
TARGET UTILIZATION
ANGSTROM ADVANTAGE: UNIFORMITY

New Shim Pattern

10 +/- 1.7

SUBSTRATE

Centerline
ANGSTROM ADVANTAGE

- NdFeB, Profiled magnets
  - Modular Design
  - Greater target utilization (85% guaranteed!)
  - Improved uniformity
  - Stainless steel encapsulation

- Solid Construction
  - 304 Stainless Steel
  - 6061 Aluminum

- Design
  - Compact Drive Assembly
  - Quick Target changes

- 2 Year Warranty
  - No-cost maintenance training
“Great all around service and product”
Aura-Gemini Observatory

“Excellent Customer Service and contact with your Technical Staff”
Eliovac

“The quality of work was exceptional, excellent custom built cathode of high quality. Greatly appreciate the time frame you were able to deliver”
Power Films, Inc.

“The product has met all our expectations. We were very impressed with the fast completion of the project. Thank you for the extra effort and satisfactory results”
Nexx Systems