ATC SERIES SPUTTERING SYSTEMS

AJA INTERNATIONAL, INC.

GENERAL INFORMATION

The AJA International, Inc. ATC Series Thin Film Deposition Systems are versatile coating tools that can be built in a wide variety of configurations to satisfy almost any requirement. These systems are built around AJA's unique A300-XP (UHV) or Stiletto Series (HV) magnetron sputtering sources which feature in-situ source head tilting allowing precise and repeatable con-focal, direct, and off-axis deposition. Larger systems are fitted with a heavy duty hydraulic hoist to lift the chamber top for system access - the chamber top swings to either side at the top of the hoist's stroke. Medium and small ATC systems feature a hinged top with gas shock assist mechanism for easy chamber access.

Substrate holders from 1" to 10" diameter are available with heating to 1000°C and/or substrate cooling from ambient to LN 2 temperatures. AJA magnetron sputter sources from 1" diameter to 12" diameter plus rectangular and triangular versions can be incorporated.

These multi-technique deposition systems can also be fitted with electron beam evaporation, thermal evaporation, Knudsen cells, PLD, ion sources for IBAD, facing target sputtering sources (FTS), contact masking systems, glove boxes, auto-loading cassette systems, RHEED, Auger analysis, and RGA's.

AVAILABLE SYSTEM SIZES (SPUTTER UP OR DOWN):

- **ATC 1300 (13” diameter)***
- **ATC 1500 (15” diameter)***
- **ATC 1800 (18” diameter)***
- **ATC 2000 (20” diameter)***
- **ATC 2200 (22” diameter)***
- **ATC 2400 (24” diameter)***
- **ATC 2800 (28” diameter)***

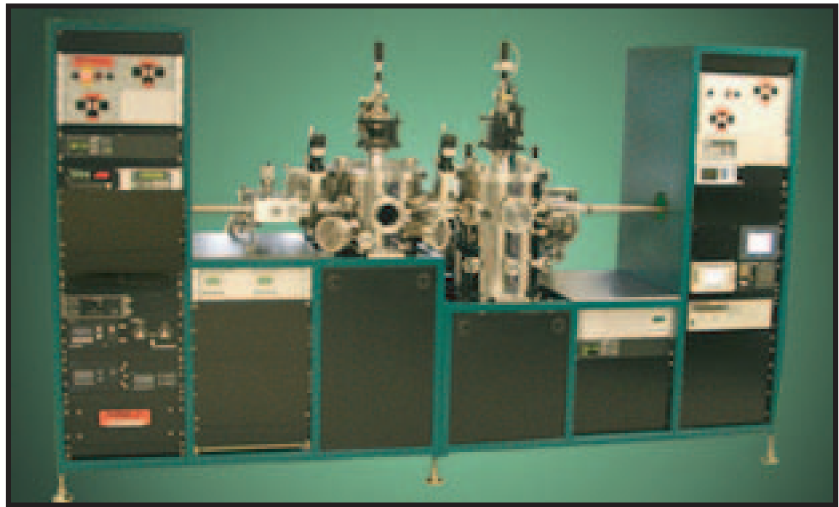
* The maximum number of sputter sources will depend on the substrate size, configuration and magnetron sputter source size. For example the ATC 1800 can be fitted with (5) 2" magnetrons with in-situ tilt. AJA offers 1", 1.5", 2", 3", 4", rectangular and triangular sources on the ATC Series. Consult factory for optimum configuration.

ATC 2000 with (6) A320-XP 2" UHV sputter sources with in-situ tilt, 1200 l/s turbopump, 850°C rotating substrate heater with RF bias, computer control and (6) substrate cassette elevator in the load-lock for 4" substrates.

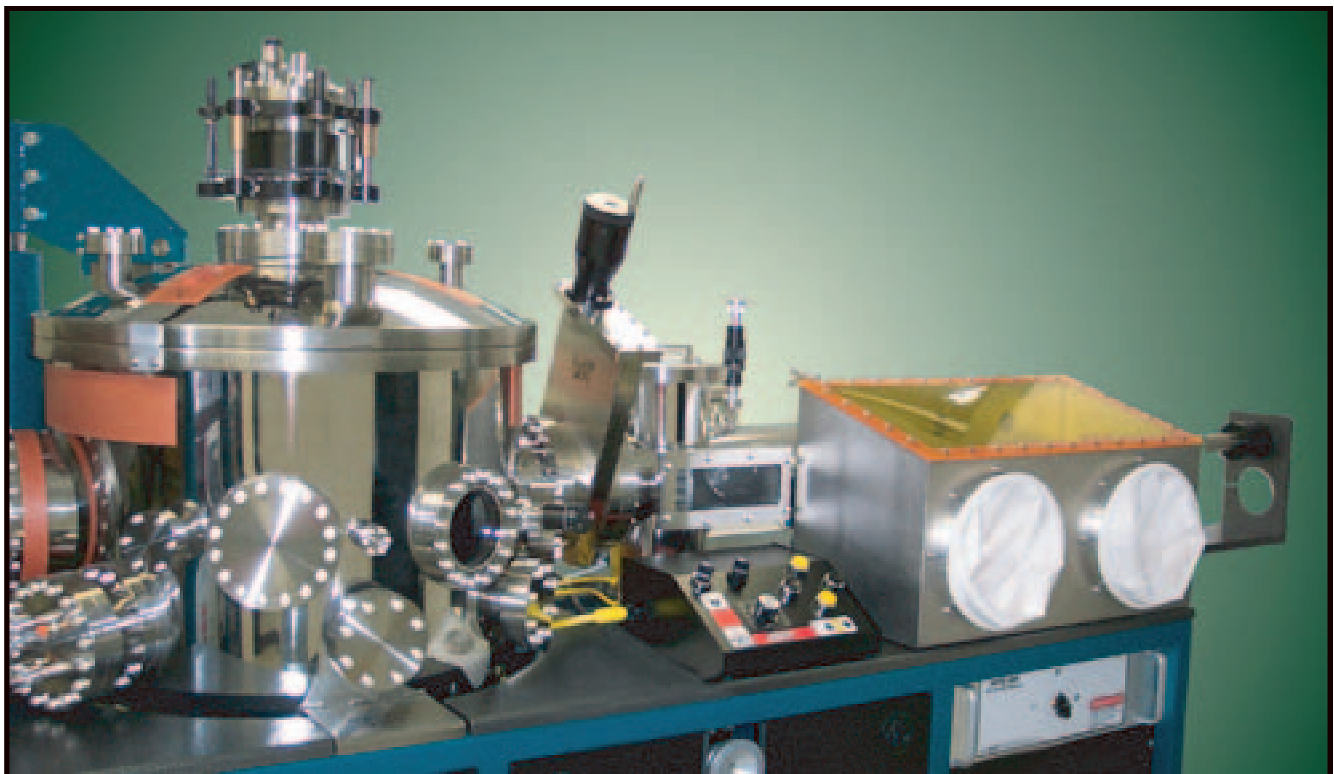
ATC 2200 IBAD with (3) A340-XP 4" UHV sputter sources with in-situ tilt, a COPRA ICP plasma/ion source for ion beam assisted deposition below 5 x 10-4 Torr, 1200 l/s turbopump, 800°C rotating substrate heater with RF bias, computer control and a load-lock for 6" diameter substrates.

AVAILABLE SYSTEM SIZES (SPUTTER UP OR DOWN):

ATC 1300 with (3) ST20 2" HV sputter sources with manual tilt, 210 l/s turbopump, 850°C rotating substrate heater with RF bias and a TSVC touch screen valve controller for automated shutter sequencing.



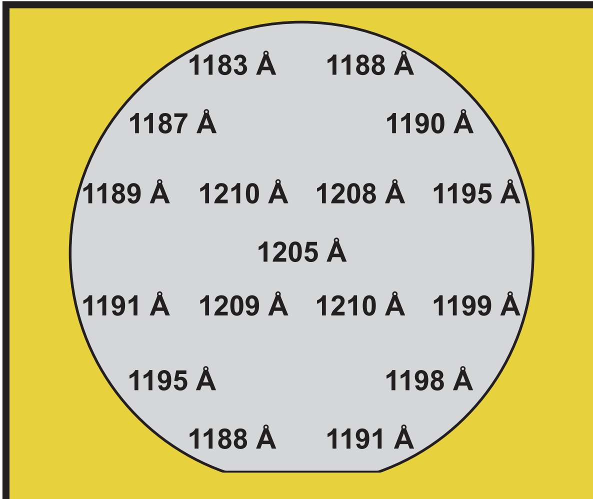
Dual UHV ATC 1500's (Sputter and Mini MBE) with (4) A320-XP 4" UHV sputter sources with in-situ tilt, (4) Knudsen cells, RHEED, 1200 l/s turbopumps, 850°C rotating substrate heaters with RF bias, computer control, load-lock for 3" diameter substrates and chamber to chamber transfer system.



ATC 2400 with (6) A320-XP 2" UHV sputter sources with in-situ tilt, (1) A3CV-HP 3.5" UHV sputter source for high pressure depositions, 1200 l/s turbopump, 600°C rotating substrate heater with RF bias, (6) position cassette load-lock with contact mask exchange, N2 glovebox for controlled environment substrate loading, and quartz lamp bakeout capability.

TYPICAL RATE / UNIFORMITY DATA

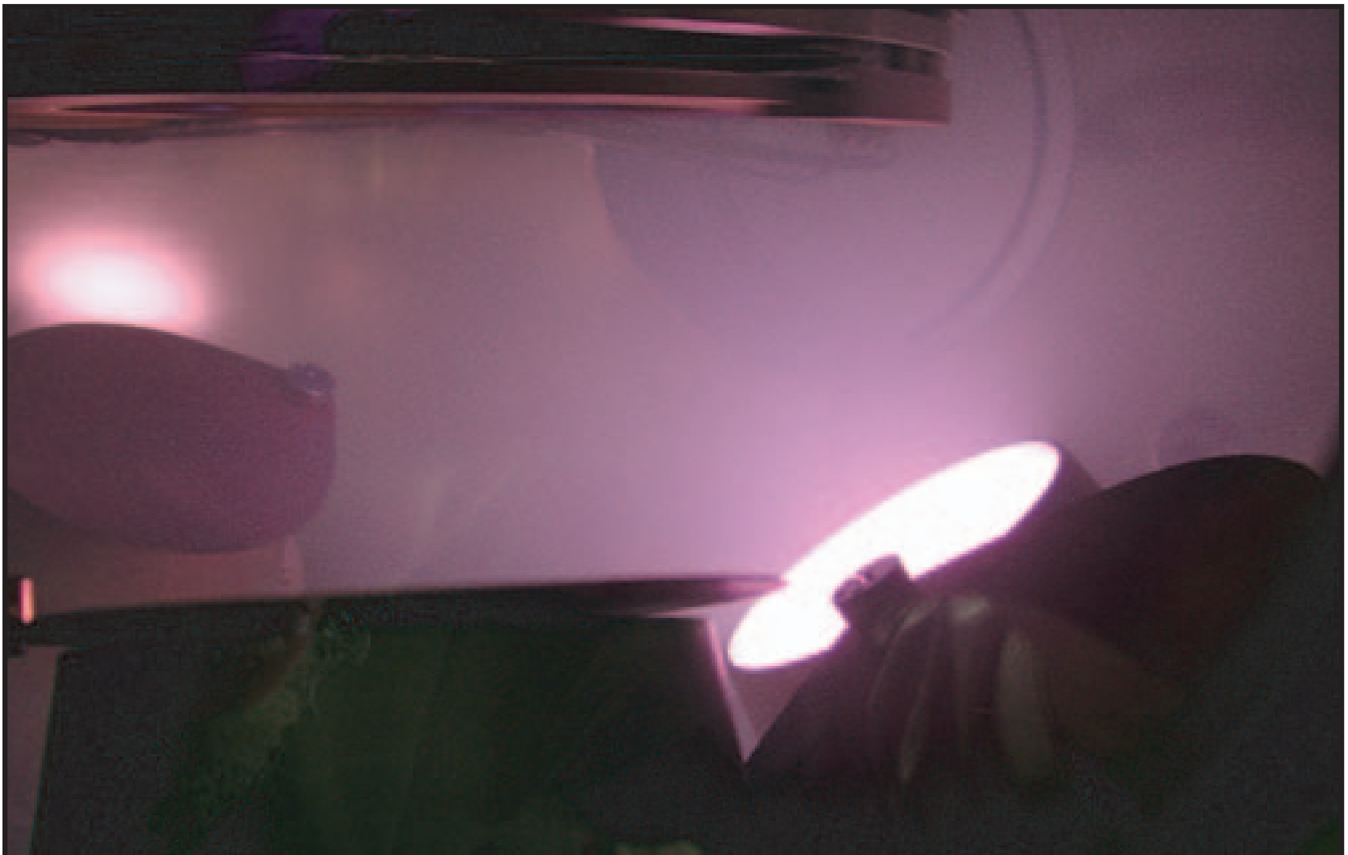
The ATC Series Thin Film Deposition Systems feature dished top and bottom flanges with individual ports to accommodate deposition sources and substrate holders. Systems can be configured for con-focal, direct, and off-axis deposition. Con-focal deposition with in-situ tilt compatible sputter sources (AJA pioneered and developed this deposition concept in 1991) can deliver uniformity of better than +/- 2% on substrates twice the diameter of the targets. Often +/- 1% or better is achievable. A typical deposition profile with SiO_2 on a 6" diameter Si wafer is shown below. Sputter deposition rate is a function of sputter yield of the material, maximum allowable power density into the target (depends on heat transfer capability of target material), and type of power used (eg. RF, DC, pulsed DC).



Deposition uniformity with A330-XP (5) Source Cluster Flange featuring in-situ tilt focused on rotating, 6.0" diameter, Si Wafer. SiO_2 deposition shows +/- 1.17% uniformity.

Maximum deposition rates are achieved with materials such as Au - high sputter yield, excellent heat transfer properties and it can be sputtered with DC (most efficient). Slow deposition rates can be expected with materials such as Al_2O_3 - very low sputter yield, poor heat transfer properties and, being non-conductive, it must be sputtered with RF (1/2 the efficiency of DC). Typical rates are 0 - 18 A /sec with Au, 0 - 9 A/sec with Cu and 0 - 0.16 A/sec with Al_2O_3. Off-axis deposition rates are typically 1-5 times lower than con-focal deposition rates depending on substrate size and system configuration.

Direct deposition at short working distances can achieve much higher rates such as 300 A /sec for Au. The ultimate configuration will depend on the application, but if extremely high deposition rates are not required, con-focal geometry offers optimum results with the best uniformity, the ability to co-deposit alloy films and the ability to grow better ultra-thin film multilayers since the substrate is always "in the plasma".



SPUTTER SOURCES

AJA's exclusive Stiletto (HV) and A300 (UHV) Series Magnetron Sputtering Sources are designed for maximum application flexibility. These unique sources feature a modular magnet array which can be configured by the customer to operate in the balanced, unbalanced (Type II) and magnetic material modes. Gas injection chimneys and shutter systems are incorporated to facilitate in-situ tilting and prevent cross-contamination and target poisoning. 3" and 4" sources can be operated at pressures below 4 x 10 -4 Torr in combination with an ion source to perform IBAD at half the price and complexity of a dual ion beam system.

UNIQUE MODULAR MAGNET ARRAY / IN-SITU TILT

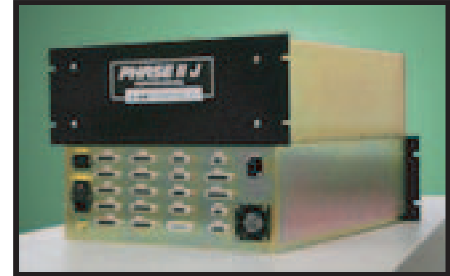
The A300XP series and Stiletto series feature a unique “modular magnet array” which is completely isolated from the cooling water to eliminate magnet deterioration and subsequent degradation of source performance. This design permits access to the internal magnet arrangement thus allowing the same source to be:

- **Configured for uniform or intentionally non-uniform depositions**
- **Operated as a balanced magnetron**
- **Configured for maximum target utilization**
- **Configured for high or low electron energies as they arrive at the substrate surface**
- **Operated with magnetic material targets and facilitating easy magnet target removal and replacement**
- **Operated in a variety of unbalanced magnetron configurations**
- **Configured for high or low rate sputtering**

For angled sputtering configurations with rotating substrates, AJA International Inc. sputtering sources can be fitted with the “in-situ tilt” option. This option, shown at the right, allows the source angle to be precisely adjusted from outside the vacuum chamber. Fine tuning the incident angle is critical to achieving good deposition uniformity when working distances, operating pressures and materials are changed. When fixed angle arrangements limit and often compromize the capabilities of a system, “in-situ tilt” can deliver better than +/- 2% uniformity on substrates which can be up to triple the diameter of the source targets.

PHASE II-J COMPUTER CONTROL

AJA International's Labview based Phase II computer control system is used on all ATC systems. This straightforward, user friendly control system utilizes a large, flat-screen laptop in a 19" rack drawer connected to a single 7" high x 19" wide rack mount hardware module. The back panel of the hardware module is populated with connectors to interface to all aspects of the sputtering system.

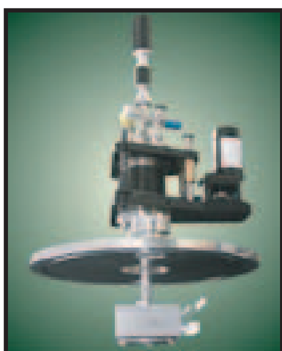


The Phase II-J control system allows the user to operate in either the "manual mode" or the "automated processing mode". In the "automated processing mode" the user designs process "layers" which are then compiled and saved as a "process". The system allows 10 unique user entry points which are accessible only by password, limiting access to a user's layers and preventing unexpected corruption of a user's saved processes.

SUBSTRATE HOLDERS / HEATERS

AJA International Inc.'s ATC Series Thin Film Deposition Systems are available with either motorized, rotating substrate holders (for con-focal configurations) or "T" arm substrate holders (for direct deposition). AJA's experienced design and manufacturing team also offers custom substrate holders to satisfy unique requirements.

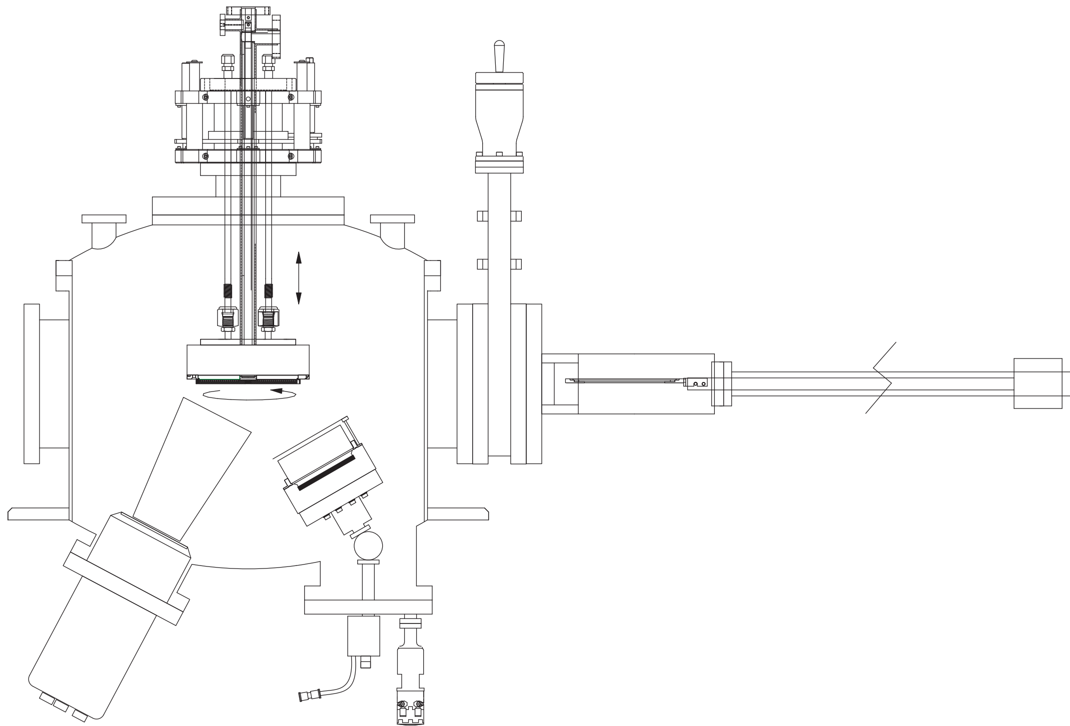
SHQ Series substrate heaters can achieve temperatures of up to 850 °C (special heaters to 1000 °C are available for small substrates) and feature reactive gas injection rings, substrate RF and DC bias capability for pre-cleaning and ion assisted deposition, in-situ manual or motorized Z motion for working distance adjustment and load-lock transfer, transverse magnetic field with in-situ orientation adjustment between layers and in-situ mask exchange (available only with certain configurations).



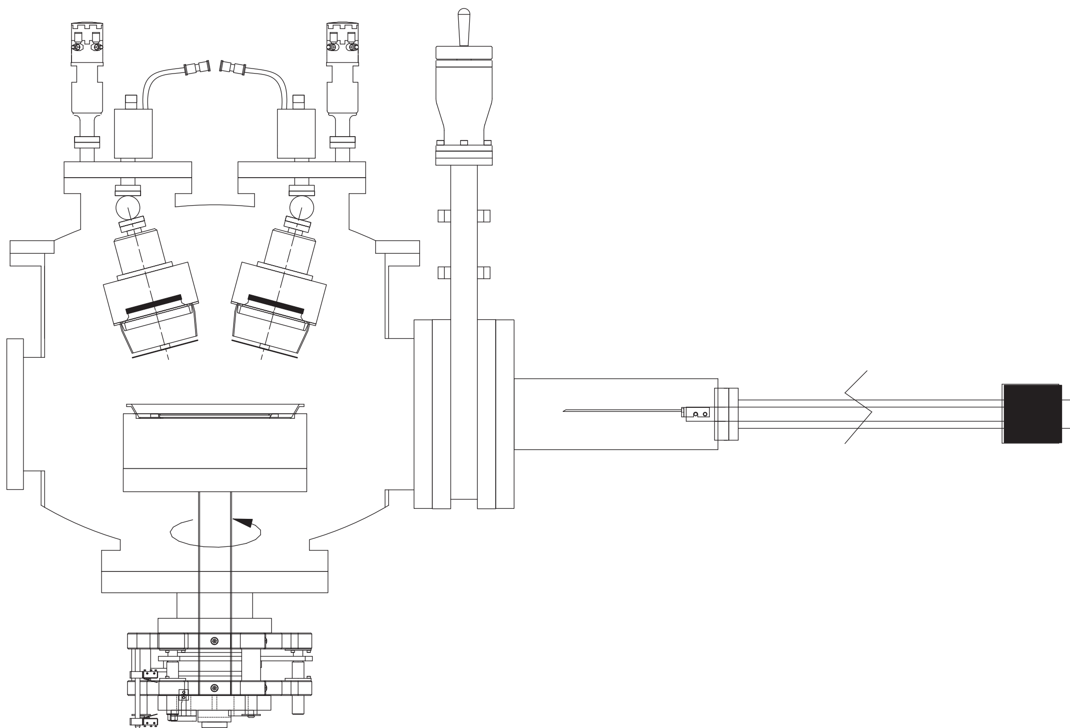
AJA International, Inc. manufactures it own PID temperature controllers and joystick actuated motor controllers for rotation and Z motion. AJA SHQ Series substrate heaters utilize cost effective, durable, fast cycling quartz halogen lamp technology. Custom cooled substrate carriers (air / water / LN 2 / LHe) are also available depending on the requirement.

SEE WWW.AJAINT.COM FOR THE LATEST DEVELOPEMENTS IN SUBSTRATE HOLDERS!

TYPICAL ATC SERIES SYSTEM SCHEMATICS

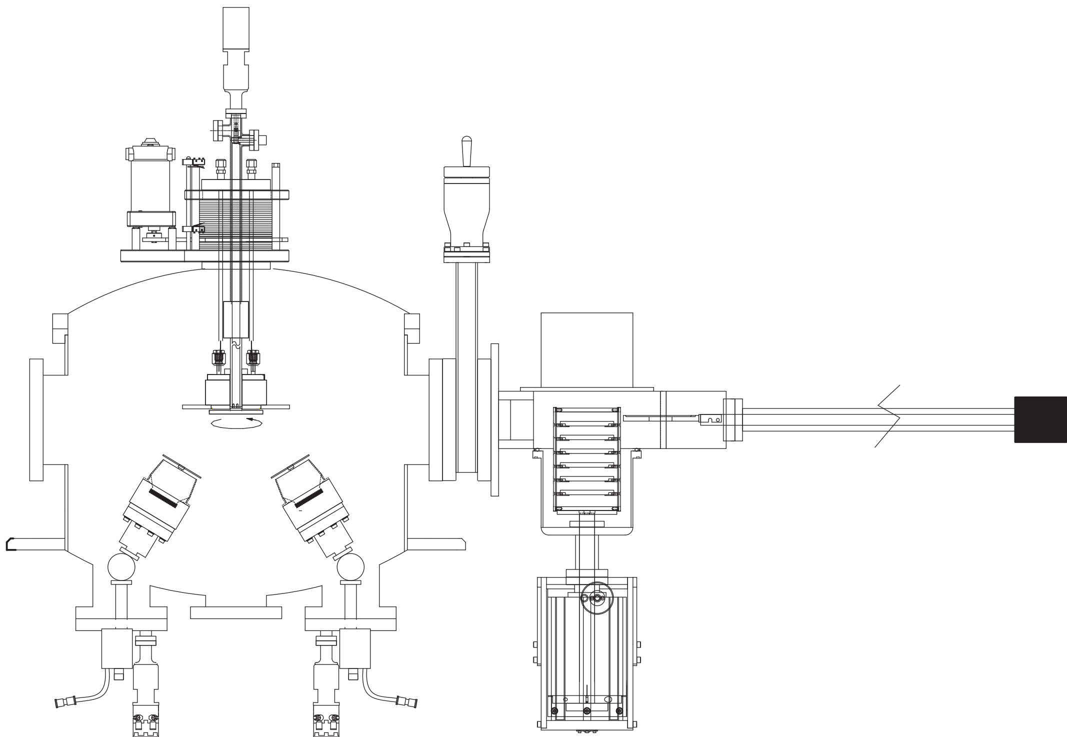


ATC 2200 IBAD with (3) A340-XP 4" UHV sputter sources with in-situ tilt, a COPRA ICP plasma/ion source for ion beam assisted deposition below 5 x 10-4 Torr, 800°C rotating substrate heater with RF bias and motorized Z motion and a load-lock for 6" diameter substrates.

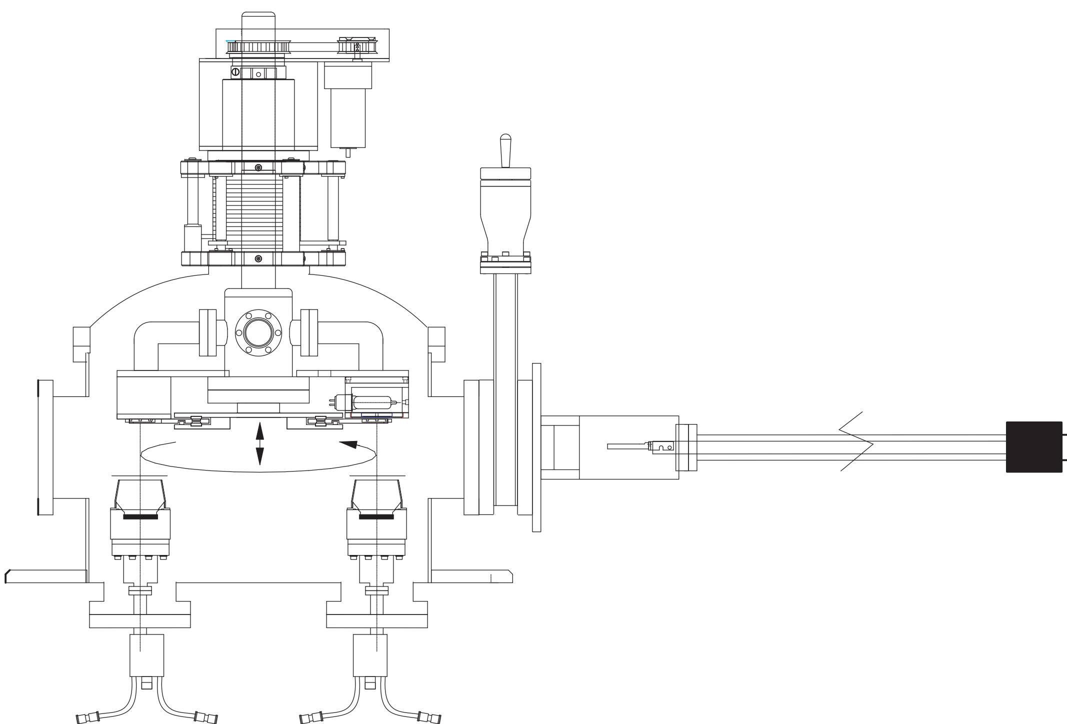


ATC 1800 Sputter Down with (3) ST-30 3" HV sputter sources with in-situ tilt, 800°C rotating substrate heater with RF bias, and a load-lock for 8" diameter transferable substrate trays.

TYPICAL ATC SERIES SYSTEM SCHEMATICS



ATC 2400 with (6) A320-XP 2" UHV sputter sources with in-situ tilt, 850°C rotating substrate heater with RF bias and motorized Z motion and cassette load-lock for (6) transferable 4" substrate carriers.

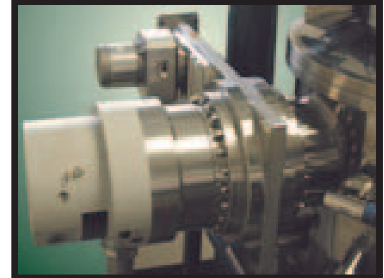


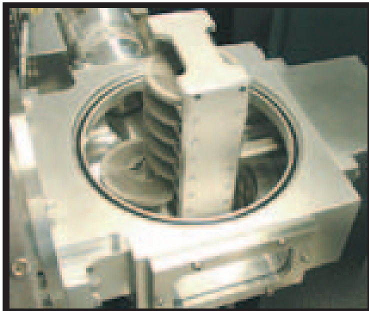
ATC 2000 with (6) A320-XP 2" UHV sputter sources, Heating/Cooling inverted "T" arm, indexing substrate holder for 1.5" diameter samples (1000°C and LN2) with RF bias, and load-lock for 4" substrates.

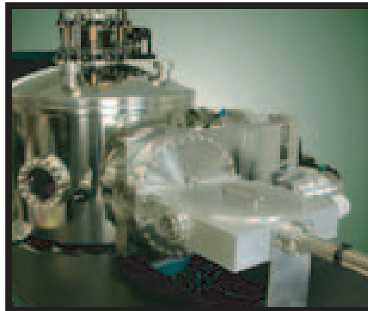
SYSTEM OPTIONS

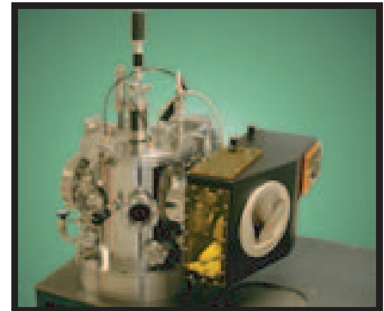
Magnetron Sputter Sources with In-Situ Tilt

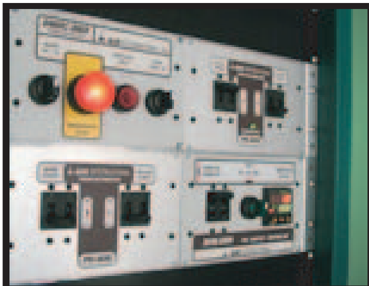
Substrate Holders with Heating / Cooling / Rotation


Wide range Turbomolecular and Cryogenic Vacuum Pumps

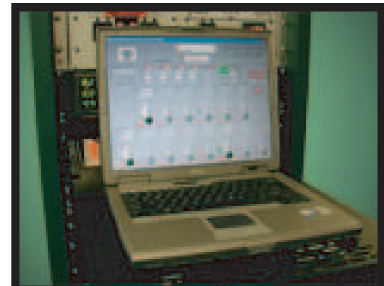

Turbo-Pumped Cassette Load-Lock for 3”, 4”, 6” and 8” Substrates


Turbo-Pumped Load-Lock for Substrates up to 8” in Diameter


Nitrogen Glove Box Load-Lock for Substrates up to 6” in Diameter

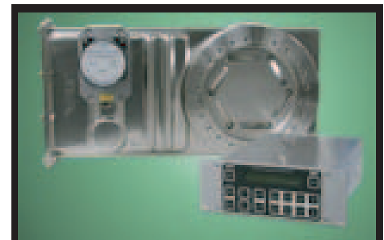

Power Distribution Modules

MFC Gas Handling


Computer Control

RF & DC Power Supplies

Targets


Automatic Pressure Control

For questions, quotes and ordering information please contact the factory:

www.ajaint.com **AJA INTERNATIONAL, INC.** **topgun@ajaint.com**

809 COUNTRY WAY * NORTH SCITUATE, MA 02066 * USA * T: 781-545-7365 * F: 781-545-4105