

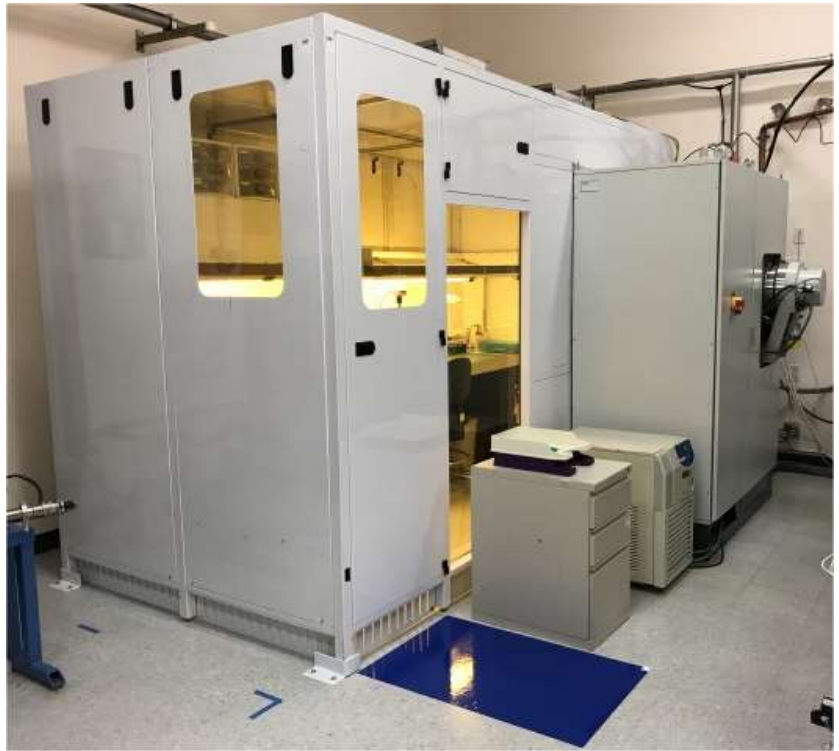
PMIC is an ISO 17025 accredited testing and R&D lab specialized in measuring thermal and mechanical properties of materials. PMIC is offering its unique and versatile thin-film deposition and characterization capabilities for research and technology development to

- **Industry,**
- **Startups, and**
- **Academic Researchers.**

Thin-film deposition, treatment, and metrology tasks can be performed either by PMIC staff as a service or by external users.

One of the main strengths and advantages of our unique technical setup is the possibility to perform an in-situ combination of efficient surface cleaning, specimen heating, and physical vapor deposition using sputtering and/or thermal evaporation.

Our 6500 sq. ft lab space accommodates a 72 sq. ft class 1000 (ISO 6) cleanroom container housing the following thin-film technique:



Cleanroom at PMIC

PVD Technique

Balzers-Pfeiffer Vacuum Laboratory System PLS-500

- Vacuum chamber 430 mm wide and 575 mm high with a large chamber door for easy access in order to load samples, modify components and clean chamber
- High-rate plasmatron sputtering
 - Deposition of metals, semiconductors, and insulators with good adhesion, step coverage, and maintained stoichiometry
 - Von-Ardenne (VAAT) planar magnetron sputter source PPS-90 UV allowing dc or rf operation
 - 90 mm diameter targets with center screw mount for cost-efficiency in the development process
 - Sputter-up process for high quality films with a thickness uniformity $\pm 5\%$ (static deposition on 2.5" substrate and 35 mm target-substrate distance)
 - DC/RF/pulsed DC power supplies: ADL TS15 (DC 1.5 kW), Advanced Energy AE MDX Pinnacle 3152326-000B dual DC 6 kW \times 6 kW 400 V, AE Dc-pulsed Sparc-Le 20, Dressler LPGC 133 (RF 300 W, 13.56 MHz)
 - Programmable process for shutter and deposition time using a STC-200/SQ Deposition Rate Controller
 - Water-cooled chamber with heated water option
- Thermal evaporation
 - Metal deposition with low impurity and low heat impact using an up to 4 kW filament evaporator
 - Sycon Instruments STC-200/SQ Deposition Rate Controller for monitoring and process automation
- Flash evaporation
 - Continuous feeding of small amounts of grain-size-fractionated material through a cooled pipe into a hot crucible using a Balzers BEF 103/201 component leads to instant thermal evaporation

- Homogeneous thin-films can be deposited from materials, such as semiconductor compounds, with different vapor pressures of their components
- Powder fabrication using a Fritsch Vibratory Micro Mill PULVERISETTE 0 and a Fritsch Vibratory Sieve Shaker ANALYSETTE 3 for various grain size fractions
- Co-sputtering option with up to 3 identical 90 mm Von-Ardenne (VAAT) plasmatrons available
 - Simultaneous sputtering using two or three targets to deposit compounds. The stoichiometry of the thin-film is controlled by optimizing the power density of each gun (target) separately.
 - An alternating sputter process using a shutter technique results in a multilayer with periods depending on sputtering time and power.
- Dry etching
 - In-situ surface cleaning, activation, and roughening with quasi-neutral plasma (mix of 1.5 – 2 keV high-energetic Ar ions and about 100 eV low-energetic electrons) in Ar-atmosphere prior thin film deposition
 - Von-Ardenne (VAAT) inverse sputtering etcher ISE-90
- Single pass or multi pass deposition of up to 6 specimen on planar 39 mm diameter rotary substrate holder with clamp mounting or magnetic mounting masks and optional openings for backside heating up to 300 °C
- Fast pump cycles with large Pfeiffer rotary vane pump DUO 035 D and Pfeiffer turbomolecular pump TPH 1600

VTD B30.2 High-Vacuum System

- Bell jar vacuum chamber with 300 mm diameter and 275 mm height for thermal evaporation
- Oil-diffusion pump EDO 160 and corona discharge capability for in-situ substrate cleaning

Treatment Capabilities

- Thermal pre and post processing in various drying ovens, vacuum ovens, furnaces, and kiln (Gress ET28) for temperatures up to 1290 °C
- Sealing of samples in quartz-glass ampoules with a defined atmosphere (e.g. Ar, N₂, vacuum) prior thermal treatment

Metrology Capabilities

- Profilometer: Tencor Alpha Step 100, range: full scale 100 µm to 100 nm, resolution: 1 nm
- Drop gauges in cleanroom and on granite table in lab
- Optical stereo microscopes: Euromex (vario 7-45× and 40-600) with 5 MP camera and software processing
- Precision scales: Chyo (resolution 0.1 µg), Sartorius CPA 225D, ATI Cahn CA-18
- Electrical measurements: Seebeck coefficient, electrical conductivity of thin-films in broad temperature range (standard: up to 100 °C; higher temperature optional)
- Laminar flow box with Hepa filter for clean sample handling in lab



Balzers-Pfeiffer Vacuum Laboratory System PLS-500

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