

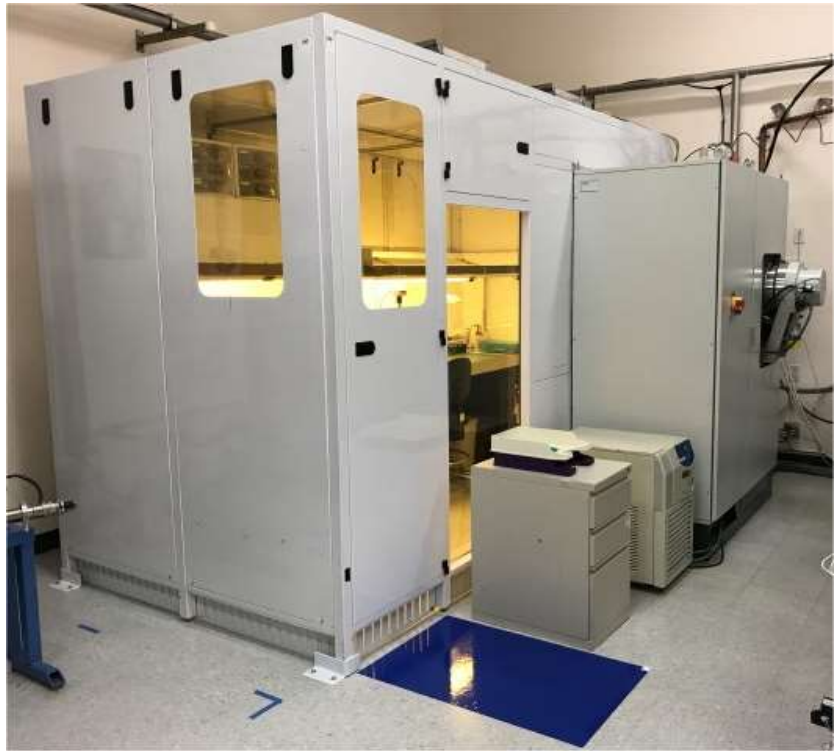
PMIC is an ISO 17025 accredited testing and R&D lab specialized in measuring thermal and mechanical properties of materials. PMIC is offering its unique and versatile thin-film deposition and characterization capabilities for research and technology development to

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

Thin-film deposition, treatment, and metrology tasks can be performed by PMIC staff.

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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