

## Sputter Deposition System

Only available at EMSL, the Discovery<sup>®</sup> Deposition System has been customized to be a fully automated multi-functional “hybrid” instrument with several modes for thin film processing, including multi-target sputtering, effusion cell deposition, electron beam deposition, and *in-situ* reflection high-energy electron diffraction (RHEED) materials characterization.

Unlike most systems, the Discovery<sup>®</sup> Deposition System’s unique configuration offers operational flexibility, efficiency, and control, allowing a range of applications and materials to be processed simultaneously. Because it is software controlled, users can provide their own “recipes” and have a complete log of what happens throughout the system process. Safety prompts also reduce the margin for error.

### Research Applications

**Fundamental science** – synthesis and *in-situ* characterization of nanoscale materials

**Sensors** – thin film growth of functional material systems for developing highly sensitive and portable chemical and biological sensors

**Energy sources** – development of thin film materials systems for research and solid oxide fuel cells and solar cells for energy generation

**Microfabrication** – deposition of patternable etch masks, sacrificial layers, and electrodes for use in microelectromechanical systems (MEMS), microfluidics, and other microsystems research



### Quick Specs

- Base Pressure:  $3 \times 10^{-8}$  Torr
- Electron Beam Evaporation Source
  - 6 kW electron beam gun power supply
  - 4 × 15 cc pockets
  - Dedicated thickness controller and automatic pocket selection
  - 32 programmable X/Y sweep patterns
- Thermal Evaporation Sources:
  - 3 effusion cells
- Water cooling for each effusion cell
  - 1 cc alumina and quartz crucibles
- Sputter Sources:
  - 3-in. diameter internal confocal mount with 3 planar magnetron sputter sources
  - Sputter-up configuration
  - Variable source to substrate distance
  - RF/DC capability
  - 1000 W solid state DC power supply
- Substrate Assembly:
  - Variable substrate size: 1 cm × 1 cm squares up to 4-in. wafers
  - Up to 900°C heating
- *In-situ* RHEED
  - 35 kV electron source
  - Magnetic shielding
- Manufacturer: Denton Vacuum LLC

## EMSL's Deposition System Offers:

**Multi-source deposition system** – simultaneous thermal evaporation from effusion cells and electron beam deposition opens up new possibilities to develop doped material systems

**Multi-target deposition system** – three sputter targets can operate in sync to obtain a wide range of compositions for desired thin films

**Reactive sputtering** – argon and oxygen gas input lines with dedicated mass flow controllers facilitate growth of oxide films

**Easy and controlled operation** – recipe-based automatic mode operation and manual control mode operation via GE's Cimplicity® Human Machine Interaction software

**Proportional-Integral-Derivative (PID) control** – PID-controlled chamber pressure and substrate heating for attaining precise and repeatable growth conditions

**Substrate rotation** – provides variable-speed, software-controlled rotation for uniform deposition on substrates

**In-situ RHEED** – provides real-time thin film growth monitoring

**Novel features** – offers EMSL users adjustable substrate-to-target spacing, multiple viewports, and the ability to use wafers up to 4 inches in diameter.



To learn more about the Discovery® Deposition System and how it is being applied to EMSL users' research, see:

<http://www.emsl.pnl.gov/capabilities/viewInstrument.jsp?id=34140>.

EMSL, a national scientific user facility, provides free instrument access for open-source research. Learn how to become a user and about upcoming proposal calls at <http://www.emsl.pnl.gov/access/calls/>

### RYAN KELLY

EMSL Microfabrication Facility  
Technical Lead  
ryan.kelly@pnl.gov  
(509) 371-6525

PNINL-SA-75580

