INFORMATION

STRUCTURES AND MATERIALS PERFORMANCE

Thin Film Coatings

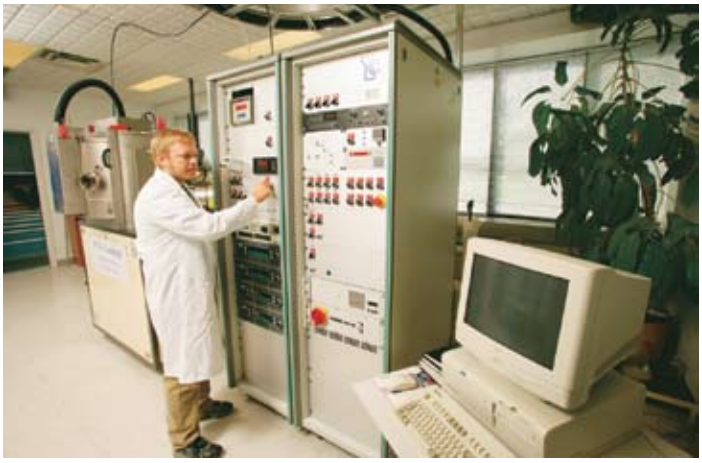
The NRC Institute for Aerospace Research (NRC Aerospace) acquired its physical vapour deposition (PVD) coater, a modern unbalanced magnetron sputter coating system with cathodic arc deposition capability, in 1998. This facility is used for pilot-scale coating production and R&D on advanced coatings and processes for a wide range of applications. The facility and related areas of expertise at NRC Aerospace are available to external clients through collaborative research or fee-for-service contracts.

The basic sputter system includes four high-field-strength unbalanced magnetrons in a closed-field configuration mounted symmetrically on the vertical walls of a cylindrical chamber. The substrates are placed on a central rotating holder. Pulsed DC power units supply power to the magnetrons and the bias potential applied to the substrates. The reactive gas flow is controlled by an optical emission feedback system, and coating system operation is fully computer-controlled.

Two cathodic arc deposition sources can be installed to replace one of the magnetrons. The coating system can then be operated in cathodic arc deposition mode or a combination of arc deposition and magnetron sputtering modes.

The presence of a high ion current density in this coater allows deposition of fully dense coatings, with good adhesion and low internal stresses at low deposition temperatures.

A number of coating types can be produced, including:
- pure metals (Al, Cr, Ti, etc.)
- alloy combinations (Al/AlMo)
- nitrides (TiN, ZrN, CrN, AlN, etc.)
- carbides (TiC, WC, Cr_3C_2, etc.)



Physical vapour deposition (PVD) coater

- alloy nitrides or carbides (TiAlN, TiZrN, TiCrN, CrZrN, TiCN, etc.)
- oxides (aluminum oxide, titanium oxide, etc.)
- diamond-like carbon (DLC) coatings
- molybdenum disulphide (MoS_2) low-friction coatings
- multilayered, nanostructured and functionally graded coatings.

Applications

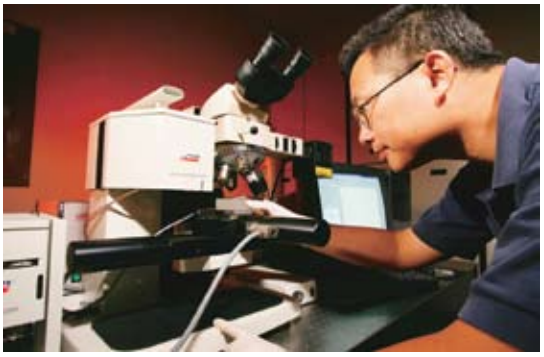
The PVD coating system can be used to produce protective coatings such as corrosion/wear/erosion resistant and low friction coatings, as well as coatings for sensor applications. NRC Aerospace is currently using this facility for research and development of:
- multilayered and nanostructured coatings to protect compressor gas path components
- alternative coatings to replace electroplated hard chrome and cadmium, and
- coatings for high-speed machining tools.

...cont'd

Coating evaluation and program support

Coating evaluation facilities are available for:

- thickness measurement
- microhardness measurement (Vickers and Knoop)
- nanoindentation (with AFM visualization)
- adhesion evaluation (scratch testing)
- wear and friction tests (POD)
- high and low angle X-ray analysis for coating structures and internal stresses
- SEM/EDX and STEM microstructural evaluation
- dry erosion evaluation per ASTM G76; up to 750°C and 300 m/s
- corrosion evaluation in potentiodynamic test per ASTM G5 and salt spray per ASTM B117
- oxidation and cyclic oxidation evaluation.



Nanoindenter

In addition, high-performance computing facilities are available for coating properties modelling using finite element (FE) and density functional theory (DFT) methods.

Technical specifications

Coating system:	• Teer UDP 650/4 closed-field unbalanced magnetron sputter ion plating system
Chamber dimensions:	• 650 mm diameter x 650 mm height
Vacuum system:	• 1,500 l/s turbomolecular pump backed by a 250 m^3/hr mechanical rotary and booster pump (Roots pump) combination, with a cryogenic pump for rapid pumping of water vapor
Power supplies:	• Five 5 kW pulsed DC power units (4 magnetrons plus substrate bias) • Arc cathodes can be powered at currents up to 100 amps
Specimen holders:	• Three-axis rotating table; rotation speeds range from 0 to 20 rpm
Specimen preheating and temperature monitoring:	• Specimen preheating with a radiation heater • Specimen temperature monitored by infrared thermometer
Process controlling:	• Fully automatic computer control; LabVIEW based operating system • Optical Emission Monitoring (OEM) for reactive sputtering; one gas line • Mass-flow controllers; three gas lines • Residual Gas Analyzer (RGA) to monitor the chamber gas environment

CONTACT:

Dr. Mariusz Bielawski
Structures & Materials Performance Laboratory
NRC Institute for Aerospace Research
Ottawa, Ontario, Canada K1A 0R6
Tel: (613) 998-8970 Fax: (613) 990-6870
E-mail: mariusz.bielawski@nrc.gc.ca

Mr. Jeff Mackwood
Marketing and Contracts Office
NRC Institute for Aerospace Research
Ottawa, Ontario, Canada K1A 0R6
Tel: (613) 990-0765 Fax: (613) 952-7214
E mail: jeff.mackwood@nrc.gc.ca

Or visit our Web site at: www.nrcaerospace.com

January 2006
Aussi offert en français
IAR-SM09e