

# Ultra-hard and Low-Friction Nanocomposite Coatings

## by High Power Impulse Magnetron Sputtering (HiPIMS)

### Technology

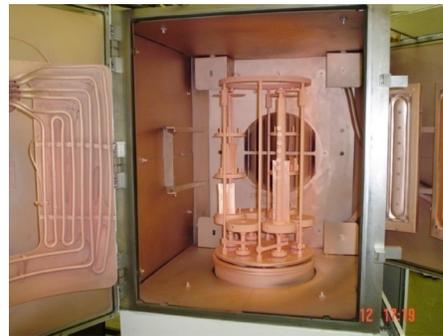
HiPIMS is an ionized physical vapor deposition (PVD) method based on conventional direct current magnetron sputtering (DC-MS). In DC-MS, very little of the sputtered material is ionized (1-3%, depending on material) since the plasma power density is not high enough. On the other hand, a large fraction of the sputtered material is ionized using the HiPIMS technique (30-90%, depending on material), resulting in smoother, harder, denser films, better adhesion to substrate, and improved coverage.

### The Project

This project is exploring the effectiveness of a revolutionary technology in industrial scale deposition systems. HiPIMS is achieving the highest possible levels of adhesion between super-hard, nanocomposite coatings and their substrates, as well as super-tough and strong cohesion within the films,

so that they cannot delaminate or crack when used under the very harsh and cyclic operating conditions of advanced manufacturing and other industrial operations.

As a case study, this project is focused on production of MoN-Cu-based nanocomposite coatings (an R&D 100 2009 winner) using the HiPIMS technique. This nanocomposite coating system has huge potential in tribological applications because of their extreme wear, scuff resistance, and very low friction coefficients (especially under severe boundary-lubricated sliding conditions).



*Argonne's  
HiPIMS-capable  
industrial scale  
physical vapor  
deposition unit*

### Facilities

The Energy Systems Division at Argonne National Laboratory has extensive coating facilities for the production of tribological coatings, as well as testing and characterization of such coatings. Argonne's user facilities (Advanced Photon Source, Electron Microscopy Center, Center for Nanomaterials) are also available. An industrial scale magnetron sputtering PVD unit is being upgraded with HiPIMS capability. HiPIMS-capable operations will begin in October 2009.

### Funding

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