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SwRI-developed Coatings Technology Earns 2009 R&D 100 Award

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On stage at the R&D 100 awards ceremony in Orlando, Fla., are (from left) Manager Dr. Kent Coulter, Principal Technician Chris Rincon, Principal Technician Edward Langa, Institute Scientist Dr. Ron Wei, Senior Technician Robert Castillo and Institute Engineer Dr. Sastry Cheruvu, all of the Mechanical Engineering Division.

A new method developed at Southwest Research Institute (SwRI) for depositing super-hard, ultra-thick coatings on components received a 2009 R&D 100 Award. *R&D Magazine* selected SwRI's Plasma Enhanced Magnetron Sputter (PEMS) technology as one of the 100 most significant technological achievements of the past year. The award was presented in a November 12 ceremony at Orlando, Fla.

Components such as jet engine turbine blades and helicopter rotor blades operate under harsh conditions, and the surfaces of these objects are often subject to severe solid particle or liquid droplet erosion. To protect these components from erosion, abrasion and wear, a surface coating is needed that demonstrates both high hardness and toughness.

"Most commercially available coatings are fairly hard, but not tough," said Dr. Ronghua Wei, an Institute scientist in SwRI's Mechanical Engineering Division and principal developer of the PEMS technology. "The SwRI-developed superhard, ultra-thick nanocomposite coating produced using our PEMS technology provides both, and has shown superior resistance in comparison to many commercial coatings."

SwRI's PEMS technology is an advanced variation of the physical vapor deposition process by which coatings can be deposited on the surface of various components. The PEMS process introduces a global plasma, which allows a thorough cleaning of a component's surface to remove oxide and surface contaminants before the coating is applied, thus ensuring that the coating tightly adheres to the surface. During the process, this global plasma enhances the ion bombardment of the coating. As a result, very dense and very hard coatings can be achieved.

Also, because a high ion flux is used, no external heaters are required, a distinct advantage over conventional methods. The high processing temperatures required for other methods often degrade the fatigue strength of the component's material.

"Although the PEMS technology can be used to deposit single-phase nitride coatings, the more important advantage of this technology is that nitride-based nanocomposite coatings also can be deposited," Wei added. "These coatings can be twice as tough as single-phase coatings, which is important for high erosion resistance. The nanocomposite coatings produced by the PEMS technology have shown extraordinary performance in field evaluations."

While designed initially for improving the surface properties of aero-engine components, land-based turbine blades and helicopter rotor blades and leading edges, the PEMS technology can be applied to a variety of components. These include oil and gas production valves and pumps; military weaponry components used in sandy or dusty environments; heavy-duty machinery engine parts and food processing components; as well as gear cutters, drill bits, lathe tools and end mills, among others.

In all, SwRI has won 34 R&D 100 Awards since 1971. ❖

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