

Sandia National Laboratories

THERMAL SPRAY RESEARCH LABORATORY

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Thermal Spray technology is a family of related processes in which molten droplets of metals, ceramics, glasses, and polymers are sprayed onto a surface to produce a coating, to form a free-standing near-net shape, or to create an engineered material with unique properties. Examples of such materials are strain-tolerant ceramics, metallic glasses, cermets, and metal/polymer composites.

Advantages & Applications

Thermal spray deposition allows materials engineers to independently optimize surface and bulk properties for specific applications, such as wear and corrosion resistance or electrical and thermal insulation. Almost any substrate material of any size can be coated. Commercially coated substrates range in size from a few millimeters to as large as the hulls of ships. Almost any material that can be melted can be sprayed. Sprayed coatings find application in many industries including: aerospace, power generation, petrochemical, automotive, marine, biomedical, infrastructure, computers, electronics, paper making, printing, and textiles.

Dr. Mark F. Smith, deputy director of Sandia National Laboratories' Materials Science & Engineering Center founded the TSRL in 1981. He was inducted into the TSS Thermal Spray Hall of Fame and was elected President of the 36,000 member ASM International materials professional society for 2010-11.

Background

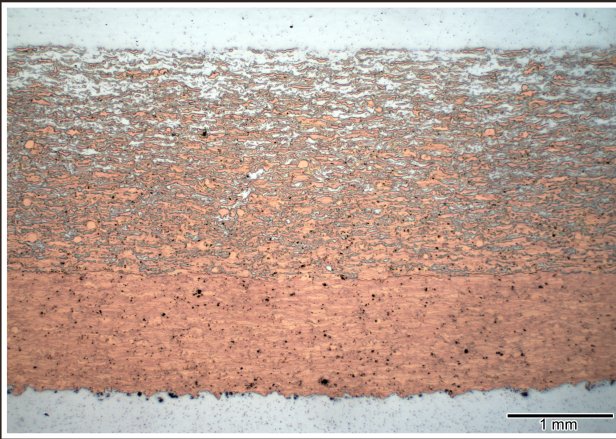
Sandia began its thermal spray research program in the 1960's to support advanced technology development for defense programs. These research efforts soon began to support a wider variety of materials and processing needs. Because program requirements continue to push the limits of available technology, thermal spray research at Sandia remains at the leading edge of spray technology. Today, with more than 30 years of experience in this highly specialized field, Sandia's Thermal Spray Research Laboratory (TSRL) is a recognized leader in the development of spray technology and ranks among the best-equipped thermal spray labs in the world. Some of the nation's largest and smallest companies have benefited from TSRL technology transfer.

The TSRL specializes in developing practical solutions to complex, multi-disciplinary thermal spray processing and materials problems. The extensive laboratory capabilities and technical expertise available throughout Sandia are best used for solving problems that cannot be adequately addressed with resources available in most industrial and university thermal spray labs. Our focus on relevant process and materials science leads naturally to improved technology.



Core Capabilities Include

- ❖ Spray Process characterization and optimization using specialized laser and other noninvasive diagnostics
- ❖ Experimental validation of analytical and computational process models to facilitate process development.
- ❖ Modifying existing spray technologies and developing entirely new spray devices.
- ❖ Developing novel engineered materials with special properties. Sprayed materials can be custom tailored with analytical and computational characterization tools to meet specific performance requirements.



Cross section of a graded density coating showing a through thickness transition from 100% copper to 100% aluminum. TSRL developed this graded coating for use as a flyer plate capable of delivering a controlled shock wave in a light gas gun impact test.

Resources

- ❖ Controlled-atmosphere plasma spray equipment. This vacuum and positive pressure system is the first and only one of its kind in the U.S. This production-scale system is equipped with a five-axis CNC manipulator and can operate over a wide range of pressures, from 1 Torr to three atmospheres.
- ❖ Various noninvasive diagnostic systems to measure particle velocities, sizes, temperatures, and chemical species in thermal spray processes. Diagnostics are integrated with computer-automated positioning and data-acquisition systems.
- ❖ Cold-gas dynamic spray, or cold spray. Sandia has a long history studying this emerging technology. High deposition rates, low oxide content, high densities, and compressive residual stresses are some of the attractive features of cold-spray processing.
- ❖ High-speed, laser-strobed video imaging systems to investigate device operation and particle dynamics. This equipment is very useful for improving device design and optimizing process parameters.
- ❖ An extensive array of thermal spray processing techniques, which include plasma, high-velocity oxy fuel (HVOF), twin-wire arc, combustion flame spray, cold spray processing, vacuum and positive-pressure plasma spray.
- ❖ Numerous analytical and numerical statistical tools for modeling particle and gas dynamics and particle impact and coating formation.

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