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# Target Fabrication Facility

Researchers at the Target Fabrication Facility are engaged in areas of science from the fundamental to the very applied. The facility houses the Laboratory's expertise in physical vapor deposition, chemical vapor deposition, polymer sciences, and precision manufacturing and assembly in support of inertial confinement fusion (ICF), high energy density physics (HEDP) experiments, and other research and development activities at Los Alamos. The facility maintains a broad program base including industrial collaborations, energy, transportation, environment, nuclear weapons, and conventional defense and supports activities in materials synthesis, processing, fabrication, and characterization. Examples of these activities include diamond chemical vapor deposition, flat panel display materials technology, high energy density materials, sensors, membranes, conducting polymers, polymer aging, low density polymeric foams, target technology, thermal barrier coatings, composite materials, lightweight structural materials, tribological coatings, nano-fabrication, and superconducting coating.

## Deposition Technologies

Physical vapor deposition (PVD) and chemical vapor deposition (CVD) are complementary processes that we use extensively to coat substrates and to make complex freestanding parts by deposition onto sacrificial substrates. As a complement to our PVD and CVD work, we use surface analytical techniques to examine coatings and other surfaces, and we support state-of-the-art instrumentation, including all the high-vacuum spectroscopies (Auger, SIMS, and ESCA).

PVD efforts are centered around three processes: electron beam deposition, magnetron sputtering, and ion beam sputtering. Using these techniques we accomplish a wide range of coating applications. For example, we develop oriented (crystalline texture) coatings, thermal barrier coatings, coating simulation techniques, and surface analysis instrumentation that have commercial and weapons utility. We deposit copper patterns on kapton to evaluate the parameters for detonation components, and we deposit multilayer combinations of metals and oxides on fiber optics for use in detonation component studies.

We apply protective coatings on uranium, produce ultrathin foils for pulsed-power experiments and neutral particle beam converters, and deposit radiochemical tracer elements on weapon components. We develop laminated thin foils as well as beryllium and plastic shells for implosion experiments. We participate in an ongoing effort to develop, produce, and characterize high-temperature superconducting thin films (involving textured films on untextured substrates) with many applications, including superconductive wires and devices, as well as accelerator cavities and radar oscillators. We also apply our PVD expertise to develop unique coatings for use in the optical and ultraviolet regions of the spectrum, we investigate magnetron deposition of erbia-doped amplifier glasses for telecommunications applications, and we perform specialized electroplating tasks for the ICF and HEDP programs.

Chemical vapor deposition and chemical vapor infiltration (CVI) coating processes are routine operations at Los Alamos and use hot wall, cold wall, and fluidized bed techniques; laser assisted and laser ablation techniques; rf, microwave, dc glow discharge, and hollow cathode plasma techniques; and organometallic CVD (OMCVD) techniques. We use these processes to produce metallic and ceramic bulk coatings and many forms of carbon including pyrolytic graphite, DLC, amorphous carbon, and diamond.

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## More about TFF

The Target Fabrication Facility is home to the Polymers and Coatings Group (MST-7) within the Materials Science and Technology Division. Approximately 67 people work at this facility, including technical staff, technicians, and administrative staff. The two story structure was completed in 1983 and is 61,000 square feet with approximately 48,000 square feet of laboratory area and 13,000 square feet of office area. In general, the structure is reinforced concrete with isolated concrete floor slabs for vibration sensitive equipment. The heating, ventilation, and air conditioning system maintains a negative pressure in the chemistry laboratories with both room air and hood exhaust vented to the atmosphere through filtered and monitored exhaust stacks. The assembly areas are maintained at positive pressure to minimize particulate infiltration. Several laboratories within the facility can accommodate operations on beryllium and tritium-containing parts.

Architect/engineer: Black & Veatch Contractor: Davis and Associates

In addition, we have deposited and extensively studied nanocrystalline films, as well as powder coatings, thin films, and monolithic shapes up to 9 cm in diameter and 1.25 cm in thickness. Using OMCVD, we produce thin film metallic, carbide, oxide, sulfide, and nitride coatings, and we are adapting OMCVD to fluidized bed, chemical vapor infiltration, and plasma assisted processing. Our effort in infiltrated materials includes the use of isothermal, thermal gradient, forced flow, and plasma techniques, and we recently developed an rf-based inverted thermal gradient technique.

## Polymers

Polymer activities use our skills in synthesis, characterization, and processing of polymeric materials to study polymer aging phenomena, polymer-based sensors and membranes, chelating polymers, electrically conducting polymers, low density foams and other porous materials, energetic polymers, composites, magnetic field processing, and liquid crystalline polymers. We maintain a nearly complete complement of characterization tools to support these research and development efforts. Our polymer processing capabilities include injection and compression molding, extrusion, filament winding, vacuum potting, fiber manufacturing, and hand lay-up of composites.

One of our current efforts is focused on polymer-based sensors for liquid process streams. We developed a sensor for on-line measurement of high acid concentrations in the negative pH range. This sensor provides accurate and fast response in hydrochloric, nitric, sulfuric, and hydrofluoric acids. We are also involved in projects to develop sensors for metal ions and some anionic species.

Polymer aging topics are as diverse as polyurethane stabilization, noninvasive testing, and lifetime prediction and are synergistic in support of our mission of science based stockpile stewardship. Unique capabilities such as the Los Alamos Neutron Science Center, combined with collaborations with many divisions throughout the Laboratory and other DOE facilities, accelerate our overall research effort.

## Precision Manufacturing and Assembly

Specialized capabilities and equipment allow us to fabricate imaginative target designs for a variety of programs. Our state-of-the-art machining capabilities include diamond turning, small hole making (5 micron), electrical discharge machining (both plunge and traveling wire), computerized numerical control (CNC) tools, and manual machine tools. These capabilities are applied to a variety of metals, including beryllium, composites, and polymeric materials. In support of these capabilities, calibrated metrology equipment is in place to verify dimensions. In addition, we maintain the Laboratory's Glass Shop, which provides glassblowing expertise in glass and quartz for prototype and customized apparatus as well as consultation on a variety of problems related to the challenges of working with glass.

The assembly function brings together much of the other work done at the Target Fabrication Facility. Routinely, we assemble five or more parts under a microscope to provide a finished package whose largest dimension is less than one millimeter. We often conduct these operations on calibrated stages because angular and spatial alignment is essential to the performance of the experiment. We have developed a repertoire of tools and techniques to respond rapidly to requests for precision assemblies and microassemblies, and we are constantly revising and updating these processes to keep pace with the Laboratory's changing needs.

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