slope of 2.1 nm/V. This slope differs from slopes (2.2 and 2.77 nm/V) reported for similar prior measurements on nanotemplates made from bulk aluminum. The differences among these slopes may be attributable to differences among impurities and defects in bulk and electron-beam-evaporated aluminum specimens.

This work was done by Nosang Myung, Jean-Pierre Fleurial, Minhee Yun, William West, and Daniel Choi of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to the Patent Counsel, NASA Management Office–JPL. Refer to NPO-40070.

Electroform/Plasma-Spray Laminates for X-Ray Optics

Properties of lightweight components can be optimized.

Goddard Space Flight Center, Greenbelt, Maryland

Electroform/plasma-spray laminates have shown promise as lightweight, strong, low-thermal-expansion components for x-ray optics. The basic idea is to exploit both (1) the well-established art of fabrication of optical components by replication and (2) plasma spraying as a means of reinforcing a thin replica optic with one or more backing layer(s) having tailorable thermomechanical properties. In x-ray optics as in other applications, replication reduces the time and cost of fabrication because grinding and polishing can be limited to a few thick masters, from which many lightweight replicas can thereafter be made.

The first step in the fabrication of a component of the type in question is to make a replica optic by electroforming a thin layer of nickel on a master. Through proper control of the electroforming process conditions, it is possible to minimize residual stress and, hence, to minimize distortion in the replica. Next, a powder comprising ceramic particles coated with a metal compatible with the electroformed nickel is plasma-sprayed onto the backside of the nickel replica. Then through several repetitions and variations of the preceding steps or perhaps a small compressive stress, alternating layers of electroformed nickel and plasma-sprayed metal-coated ceramic powder are deposited.

The thicknesses of the layers and the composition of the metal-coated ceramic powder are chosen to optimize the strength, areal mass density, and toughness of the finished component. An important benefit of using both electroforming and plasma spraying is the possibility of balancing stresses to a minimum level, which could be zero or perhaps a small net compressive stress designed to enhance the function of the component in its intended application.

This work was done by Melville P. Ulmer, Michael Graham, and Semyon Vaynman of Northwestern University for Goddard Space Flight Center.

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:

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