



Improved Small-Particle Powders for Plasma Spraying

Minimum layer thicknesses needed for complete coverage are reduced.

John H. Glenn Research Center, Cleveland, Ohio

Improved small-particle powders and powder-processing conditions have been developed for use in plasma spray deposition of thermal-barrier and environmental-barrier coatings. Heretofore, plasma-sprayed coatings have typically ranged in thickness from 125 to 1,800 μm . As explained below, the improved powders make it possible to ensure complete coverage of substrates at unprecedentedly small thicknesses — of the order of 25 μm .

Plasma spraying involves feeding a powder into a hot, high-velocity plasma jet. The individual powder particles melt in the plasma jet as they are propelled towards a substrate, upon which they splat to build up a coating. In some cases, multiple coating layers are required. The size range of the powder particles necessarily dictates the minimum thickness of a coating layer

needed to obtain uniform or complete coverage. Heretofore, powder particle sizes have typically ranged from 40 to 70 μm ; as a result, the minimum thickness of a coating layer for complete coverage has been about 75 μm .

In some applications, thinner coatings or thinner coating layers are desirable. In principle, one can reduce the minimum complete-coverage thickness of a layer by using smaller powder particles. However, until now, when powder particle sizes have been reduced, the powders have exhibited a tendency to cake, clogging powder-feeder mechanisms and feed lines.

Hence, the main problem is one of synthesizing smaller-particle powders having desirable flow properties. The problem is solved by use of a process that begins with a spray-drying subprocess to produce

spherical powder particles having diameters of <30 μm . (Spherical-particle powders have the best flow properties.) The powder is then passed several times through a commercial sifter with a mesh to separate particles having diameters <15 μm . The resulting fine, flowable powder is passed through a commercial fluidized-bed powder feeder into a plasma spray jet.

This work was done by QuynhGiao N. Nguyen and Robert A. Miller of Glenn Research Center and George W. Leissler of QSS Group, Inc. Further information is contained in a TSP (see page 1).

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Commercial Technology Office, Attn: Steve Fedor, Mail Stop 4-8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-17433-1.

Bonding-Compatible Corrosion Inhibitor for Rinsing Metals

Strong adhesive bonds can be made after rinsing with corrosion-inhibiting solutions.

Marshall Space Flight Center, Alabama

A corrosion-inhibiting mixture of compounds has been developed for addition to the water used to rinse metal parts that have been cleaned with aqueous solutions in preparation for adhesive bonding of the metals to rubber and rubberlike materials. Prior to the development of this corrosion inhibitor, the parts (made, variously, of D6AC steel and 7075-T73 aluminum) were rinsed by deionized water, which caused corrosion in some places on the steel parts — especially in such occluded places as sealing surfaces and threaded blind holes.

An integral part of the particular cleaning process is the deposition of a thin layer of silicates and silane primers that increase the strength of the adhesive bond. The corrosion inhibitor is formulated, not only to inhibit corrosion of both D6AC steel and 7075-T73 aluminum, but also to either increase or at least not reduce the strength of the adhesive bond to be formed subsequently. The corrosion inhibitor is a mixture of sodium silicate and sodium tetraborate. The sodium

silicate functions as both a corrosion inhibitor and a bond-strength promoter in association with the silane primers. The sodium tetraborate buffers the rinse solution at the optimum pH and functions as a secondary corrosion inhibitor for the steel.

For a given application, the concentrations of sodium silicate and sodium tetraborate must be chosen in a com-

promise among the needs to inhibit corrosion of steel, inhibit corrosion of aluminum, and minimize cosmetic staining of both steel and aluminum. Concentrations of sodium silicate in excess of 150 parts of silicon per million parts of solution (ppm Si) have been determined to enhance inhibition of corrosion; unfortunately, because of



In a Blind Hole in a D6AC Steel Specimen washed with deionized water, corrosion products can be seen on the thread (a). There is no visible sign of corrosion in a similar specimen rinsed with the corrosion-inhibited solution (b).