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Manganese–Alumina–Ceramic Glass Eliminates Rigid Controls Necessary in Bonding Metals to Ceramics

The problem:

To simplify the process of metallizing alumina ceramics. A metallizing mixture is needed that can be fired in hydrogen of variable moisture content on any available alumina ceramic with a reduced metallizing firing temperature to help prevent undesirable side effects such as grain growth and warping.

The solution:

A matrix of manganese-alumino-silicate glass. This matrix will bond metal molybdenum powder, for instance, to alumina ceramics with the same kind of chemical–mechanical bonding structure found in conventional metallizing. Use of the matrix eliminates the intermediate reaction steps necessary in the molybdenum–manganese process. Because the manganese in the glass is preoxidized to the 2+ state by firing in nitrogen, the ceramic can be metallized in dry hydrogen. Lengthening the firing time permits a lower metallizing temperature.

How it's done:

Manganese–alumino-silicate glasses are prepared by melting manganous carbonate, silica, and alumina powders in a platinum crucible at 1450°C in a nitrogen atmosphere. Suspensions of the powdered glasses with powdered molybdenum are brushed onto ceramic plates and fired at 1400°C for 45 minutes in hydrogen. The metallized surface can then be nickel plated, for instance, and brazed to Kovar plates with a gold–nickel alloy. Grain boundary penetration of the ceramic creates a mechanical bond that augments the chemical bond at the ceramic–glass interface. Since it is the glass that forms the matrix with the metal particles dispersed throughout, this bonding technique can be applied to other metals in the 4B, 5B, and 6B series, providing the coefficient of expansion of the glass mixture is higher than that of the metal and the metal is chemically compatible with the glass.

Note:

Inquiries concerning this innovation may be directed to:

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Patent status:

No patent action is contemplated by AEC or NASA.

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