December 1970 Brief 70-10674

NASA TECH BRIEF

Oxidation-Resistant Coatings for Refractory Metals Used in Inert Atmospheres

Portions of refractory-metal parts of high-temperature power systems are commonly exposed to inert atmospheres containing traces of oxygen and other impurities. Protection by an oxidation-resistant coating may be desirable and/or necessary. Selection of the coating must be based on its effectiveness in preventing oxidation, and on its reactive effect on and protection of the substrate. The test results reported are for various coatings on a 1%-zirconium columbium alloy at a temperature of 2000°F. The 2-by-0.5-in. specimens were cut from 1/8-in. sheet stock. The argon atmosphere contained oxygen at from 1 to 3 ppm. The water-vapor content decreased from an initial value of less than 10 ppm to from 1 to 3 ppm within 24 hours.

Specimens PCA and PCB received single-cycle coatings of a proprietary material; specimens PCC and PCD received two-cycle coatings. Specimens S-1, S-2, and S-3 received tin-aluminum coatings. Four more specimens were coated with KA-1, KA-2, KA-3, and KA-4. (KA refers to a specific manufacturer's designation.) Three specimens, VCA, VCB, and VCM, received 0.003-in. coatings of modified chromium-molybdenum disilicide. A fourth (VCM-5) in this series was coated (by halide decomposition)with 0.005 in. of molybdenum topped with an unmodified molybdenum disilicide.

After 500 hours at 2000°±25°F, the specimens were cooled five times to 70°F before being reheated to 2000°F. Each cooling cycle took approximately 12 hours; the heating cycles required approximately 6 hours. The depth to which the coating diffused into or contaminated the substrate was evaluated by metallography, microhardness testing, and microprobe analysis. A diamond-pyramid indenter and a 25-g load on a Tukon tester were used for the microhardness.

Molybdenum silicide over molybdenum appeared to be the most effective coating. The chromium-molybdenum silicides were not protective and caused diffusion of chromium into the substrate. All PC and KA coatings permitted some oxidation of the substrate. The tin-aluminum coating adequately inhibited oxidation in two of the three specimens, with little evidence of contamination in the third; thus it is believed to be adequately protective.

Note:

The following documentation may be obtained from:

National Technical Information Service
Springfield, Virginia 22151
Single document price $3.00
(or microfiche $0.65)

Reference:
N67-15683, Evaluation of Oxidation-Resistant Coatings for Inert-Atmosphere Applications

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to:

Patent Counsel
Mail Code 1
NASA Pasadena Office
4800 Oak Grove Drive
Pasadena, California 91103

Source: W. M. Phillips of
Caltech/JPL
under contract to
NASA Pasadena Office
(NPO-11477)

Category 04