NASA TECH BRIEF

Langley Research Center

Applying High-Emittance and Solar-Absorptance Coating to Aluminum

A process has been developed at Langley Research Center for producing a surface coating which has a high, total hemispherical emittance and a high absorptance, over the 0.25- to 25-micrometer wavelength range, and a relatively flat spectral distribution. The values of emittance (covering the wavelength range of from 1 to 25 micrometers) and solar absorptance (covering the range of from 0.25 to 2.6 micrometers), obtained by the process to be described, are 0.93 and 0.97, respectively. A surface coated in this manner is able to withstand the space environment (which includes high vacuum, ultraviolet radiation, micrometeoroids, and ionizing radiation) with negligible change in its radiation characteristics and its physical properties.

This coating can be applied to aluminum or aluminum alloy as thin as 0.003 inch (0.076 mm), with negligible weight increase.

The application of this coating process is accomplished in three steps: (1) the surface is anodized, (2) then it is dyed with inorganic nickel sulfide, and (3) the coating is sealed.

The initial step is to clean the aluminum or aluminum alloy of surface contaminants, using standard techniques. The sulfuric acid method is then used for anodization under the following conditions:

Electrolyte – 15% sulfuric acid;
Current density – 0.01725 A/cm^2;
Temperature – 302 to 305 K; and
Time – 45 to 120 minutes.

This produces a coating of aluminum oxide which is a highly porous, noncrystalline honeycomb film.

The second step involves formation of nickel sulfide by reacting two different solutions inside the pores of the film. To accomplish this, the anodized aluminum is placed in a solution of nickel acetate (50 g/l, pH of 6) at room temperature for 2-3 minutes. It is immediately immersed into concentrated ammonium hydrosulfide for 2-3 minutes and then rinsed in demineralized or distilled water. This cycle is repeated three or four times, or until the material is black.

The coating is sealed by placing the dyed anodized material into water for a period of 10 minutes. The water should be at a temperature between 90.5° and 93.3° C and have a pH of 5.5 to 5.8.

This process can be used with any porous substance, as long as the pores are large enough to allow the molecules of reacting solutions to enter and yet not so large as to allow the nickel sulfide to be leached out of the pores before sealing.

Note:

Requests for further information may be directed to:

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Patent status:

Inquiries concerning rights for the commercial use of this invention should be addressed to:

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