NASA TECH BRIEF

Marshall Space Flight Center

Investigation of Environmental Effects on Coatings for Thermal Control

The advances made in studies on pigmented coatings for use in regulating the temperature of satellites and large space vehicles may offer significant improvements in earth-bound applications. Two techniques are used for controlling the temperature of satellites and space vehicles: the active technique usually requires both electrical power and moving parts; the passive technique utilizes surface materials which have appropriate thermophysical characteristics. It is due to the passive technique that extensive work has been done in the area of materials used for the coatings.

Major accomplishments made during the study of coatings included the development of a structure/property theory that relates to the selection of the most appropriate pigments for employment as space vehicle paints. Also, improvements were made in a zinc-oxide-pigmented potassium silicate paint and a silicated zinc-oxide-based silicone elastomer coating, the latter being currently used as prime thermal control on numerous satellites and spacecraft. The rationale was developed for selection of silicone binders that led to the discovery of "glass" resin as the most stable resin binder commercially available. Ultraviolet-damage mechanisms in semiconductor pigments and also plasma annealing have been investigated so that it is understood how the reactively-encapsulated zinc orthotitanate can be stabilized against combined ultraviolet-plus-proton irradiation.

To study properties of pigments, a 12-specimen In situ Reflectance/Irradiation Facility (IRIF) and the Combined Radiation Environmental Facility were designed and constructed. The Combined Radiation Environmental Facility simultaneously deposits ultraviolet at 1X to 4X solar-ultraviolet acceleration factors and 1.2 keV protons from 1.5X to 250X solar-wind acceleration factors.

Additional contributions of this study include the development of stable, reactively-encapsulated zinc orthotitanate-pigmented potassium silicate paint having a nominal solar absorptance, α_s, of 0.1 and a $\Delta\alpha_s$ of less than 0.01 in 1000 ESH of ultraviolet radiation in vacuum.

Also developed during the study program was a stable plasma-annealed, reactively-encapsulated zinc orthotitanate paint based on "glass" silicon resin that possesses a nominal α_s of 0.2 and a $\Delta\alpha_s$ of much less than 0.01 in 2000 ESH of ultraviolet irradiation in vacuum.

Note:

Requests for further information may be directed to:

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Patent status:

NASA has decided not to apply for a patent.

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