NASA TECH BRIEF

Marshall Space Flight Center

Study of In-Situ Degradation of Thermal Control Surfaces

A study has been made of the damage mechanism to semiconductor pigments exposed to ultraviolet radiation. The experimental technique used in this study is of broad interest for two reasons: it may be more widely used for investigations of surface chemistry, and it may be used analytically to determine contamination.

The materials investigated were binderless films of zinc oxide (ZnO), rutile titania (TiO_2), and zinc orthotitanate (Zn_2TiO_4). Each of these was exposed to ultraviolet radiation in a vacuum, causing changes in the reflective properties of the pigment. Since it was already known that damage to the pigments could be "bleached out" by air, test gases (O_2, CO_2, and CO) were added in definite increments. This made it possible to study the reversal of the damage and draw conclusions about both the bleaching and the damaging of the pigments.

At each stage of the experiment, reflective spectra (from 0.325 μm to 2.6 μm) were taken in situ, to determine how gas pressure affected adsorption. The ZnO and the Zn_2TiO_4 exhibited a square root dependence on oxygen pressure, suggesting monatomic oxygen adsorption and desorption. Ultraviolet damage to TiO_2 appeared to involve at least two types of defects; at least one of which was surface oxygen related. Carbon dioxide (CO_2) did not seem to be involved in any of the surface reactions, but evidence suggested CO may react with adsorped or lattice oxygen to form CO_2.

Note:

Additional information may be obtained from:

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No patent action is contemplated by NASA.

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