SIMULATION AND MEASUREMENT APPARATUS

This is a division, of application Ser. No. 843,944 filed July 23, 1969 now abandoned.

BACKGROUND

In the design and construction of vehicles for use in space, the temperature of the vehicle and selected parts thereof is of considerable significance. In order to control the temperature of the space vehicle it is common to provide special coatings on selected portions of the vehicle for temperature control. These thermal control coatings may have, for example, a high reflectivity in the energetic ultraviolet and visible portions of the spectrum in order to reject heating from the sun and may also have a relatively high emissivity in the infrared region so that heat generated aboard the spacecraft or absorbed from the sun can be radiated into space.

The thermal control coatings employed on spacecraft are operated in a severe environment involving high vacuum, unusual temperature regimes, irradiation by ultraviolet and bombardment by protons and similar solar particles. In this severe environment the thermal control coatings may undergo chemical and physical changes which affect the optical properties of the coating. Organic and inorganic binders employed in the coatings may be decomposed and the pigments themselves may be changed so that the optical performance of the coating is degraded.

Because of the very large investment involved in subjecting a candidate coating to the environment of space it is desirable to provide an apparatus for simulating space conditions to which a coating will be subjected and also to provide means for measuring the optical characteristics of a coating before and after exposure to the simulated environment. The measurements of optical properties should be made without removing the specimen from the vacuum of simulated space since exposure to air or other gases may further change or degrade the optical properties of the coating.

SUMMARY OF THE INVENTION

Thus in the practice of this invention according to a preferred embodiment there is provided apparatus for simulating solar radiation in space and measuring optical properties of materials exposed to the radiation, comprising an evacuable chamber with sources of ultraviolet and particulate radiation for exposing a specimen, and a transport mechanism for transporting a specimen between an exposure station and a measurement station. An optical integrating sphere is provided for optical reflectivity measurements at the measurement station.

DRAWINGS

Objects and many of the attendant advantages of this invention will be apparent as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. 1 illustrates a partial cutaway view of a solar simulator and measurement apparatus constructured according to the principles of this invention;

FIG. 2 illustrates another partial cutaway view of the apparatus including a showing of a transport mechanism;

FIG. 3 illustrates a support wheel for the transport mechanism;

FIG. 4 illustrates a cross-section of a specimen mounting station of the transport mechanism;

FIG. 5 illustrates in longitudinal cross-section a movable hermetic feed-through for heat transfer fluids;

FIG. 6 illustrates a longitudinal cross section of a heat exchanger;

FIG. 7 comprises a transverse cross-sectional view of the heat exchanger of FIG. 6;

FIG. 8 illustrates schematically the optical arrangement at a measuring station in the simulator;

FIG. 9 illustrates in cross-section an integrating optical sphere at the measurement station;

FIG. 10 illustrates in cross-section another integrating optical sphere for absolute reflectivity measurements; and

FIG. 11 illustrates another view of the sphere of FIG. 10.

Throughout the drawings like reference numerals refer to like parts.

DESCRIPTION

FIGS. 1 and 2 illustrate in partial cutaway two views of a solar simulator and measurement apparatus incorporating the principles of this invention. As illustrated in this embodiment there is provided an evacuable cylindrical lower housing **10** to which are connected conventional non-contaminating, ultra-high vacuum pumps (not shown) for obtaining an ultra high vacuum approximating that of space within the housing. A plurality of conventional vacuum tight feed-throughs **11** are provided around the lower housing for various ancillary functions of the apparatus such as admission of gases to the inner chamber, gauges for measuring vacuum, electrical leads for components within the vacuum chamber and the like. A cylindrical upper housing **12** is clamped to the lower housing **10** by a conventional high vacuum flange **13.** The upper housing **12** also includes an upstanding semi-cylindrical portion **14** for providing access to a measuring station as hereinafter described in greater detail. Within the upper housing **12** there is also an opaque partition **16** which is substantially a continuation of the flat wall of the semi-cylindrical housing portion **14.** An exposure aperture **17** is provided in the partition **16** which divides the upper housing **12.**

In the cylindrical portion of the upper housing **12** there is provided a conventional ultra-violet source **18** such as a high energy, high pressure, mercury capillary lamp, xenon or neon filled lamp or the like. The selection of a particular model of ultraviolet source depends on the intensity and spectrum of ultraviolet radiation desired either approximating solar radiation intensity or exceeding solar intensity for accelerated testing. If desired an external solar simulating source can be employed to project a light beam through a window in the chamber and onto the specimen. If this is done a radiometer, Faraday cup or the like can be located where the ultra-violet source **18** is in the illustrated embodiment.

A conventional ultraviolet radiometer **19** is provided in an aperture in an opaque floor **20** for measuring the intensity of ultraviolet radiation from the ultraviolet source **18.** A proton source **21** (FIG. 2) is mounted on the upper housing **12** so as to irradiate the aperture **17** with particulate radiation simulating that of space.