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NASA TECH BRIEF

Lyndon B. Johnson Space Center

Inexpensive Lightweight Mirror

A new technique has been developed for the low-cost manufacture of low-density mirrors of optical quality. The mirrors will withstand temperatures from –34° to 93° C (–30° to 200° F) and 90 percent humidity. A 0.95-cm (3/8-in.) thick mirror made by this technique is mechanically stable and has a density less than 0.07 g/cm^3 (0.0025 $lb/in.^3$). Specular reflectivity is greater than 85 percent in the 2800- to 5500-Å wavelength region, and the mirror surface is of good quality.

To make the mirrors, an aluminized Mylar film is bonded to a polyurethane foam mold; the Mylar is then removed, leaving a highly reflective coating of aluminum on the foam. Large mirrors of almost any shape may be made singularly or in quantity. For example, the technique described here was used to manufacture concave mirror quadrants with radii of curvature of 101.6 and 63.5 cm (40 and 25 in.) across.

To construct the concave mirrors, a master mirror is accurately machined and polished to remove any imperfections. From this an epoxy mold is formed and is also polished to remove imperfections. A sheet of aluminized Mylar [0.03 mm (3 mils) thick] is stretched tightly on the mold with the aluminum side up. There must be no gaps between the Mylar and the mold. Then a thin coat of epoxy shell is applied to the Mylar with a very soft brush. Following this, a rigid polyurethane foam piece, accurately machined to match the mold, is pressure clamped over the epoxy-coated Mylar on the mold.

The clamped foam and mold are allowed to dry completely, and the clamp is removed. The foam and mold are then separated. Since the coefficient of adhesion of aluminum to epoxy is much greater than for aluminum to Mylar, the aluminum is transferred to the thin epoxy coating which is in turn bonded to the foam. None of the Mylar transfers to the epoxy coating, only the aluminum.

The mold may be used repeatedly to make mirrors for several optical instruments. These mirrors have been used in light detectors in a gas Cerenkov counter and could be used in other devices requiring light weight. The fabrication is less costly than conventional vacuum deposition techniques and thus may also be of interest for the manufacture of mirrors without weight restrictions.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
Johnson Space Center
Code AT3
Houston, Texas 77058
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Patent status:

NASA has decided not to apply for a patent.

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