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Moisture-Resistant Coatings for Optical Components

The problem:

To protect moisture-sensitive optical components, such as the cesium iodide or sodium chloride windows used in spectroscopy. The usual techniques of maintaining critical optics under an atmosphere of dry or inert gas, enclosing them in polyethylene envelopes, or keeping them in closed compartments with desiccants are not always convenient or satisfactory.

The solution:

Use a plasma polymerization technique to apply thin, adherent, hydrophobic coatings from chlorotrifluoroethylene monomer.

How it's done:

The optical component is supported on pins inside the bell jar of a typical vacuum coating apparatus. The bell jar is evacuated to a background pressure of less than 0.13 N/m^2 (10^{-3} torr), and chlorotrifluroethylene (CTFE) is admitted via a needle valve. System pressure, controlled by the flow of CTFE, is stabilized at about 0.32 to 0.64 N/m^2, and then argon or inert gas is allowed to enter the bell jar through a tube which directs the stream substantially onto the upper surface of the optical component. When the total pressure (CTFE flow and argon flow) is at about 27 N/m^2, rf energy is applied to the gas stream until a discharge is initiated and can be maintained at 30 watts input. The system is operated under these conditions for 30 minutes, and then the substrate is turned over and exposed to the plasma for an additional 30 minutes; this assures uniform coating even though the plasma pervades all substrate surfaces.

Typically, the film formed on an infrared window is thin (0.10 μm or less), and adheres firmly to the entire surface; it is free of pinholes and is moisture resistant. A crystal of cesium iodide coated by plasma polymerization is stable for at least 400 hours at 88.8% relative humidity. Under the same conditions, an uncoated crystal etches severely in two minutes.

As prepared by plasma polymerization, films resemble polytetrafluoroethylene; apparently much of the chlorine contained in the original monomer is lost during polymerization, and the characteristic C-Cl absorption in the infrared region is essentially absent. The films have transmittances of about 90% over the range 1400–400 cm^{-1}; large absorptions at 1180 cm^{-1} are inevitable inasmuch as they are caused by C-F bond stretching.

Reference:

Hollahan, J. R., and Wydeven, T.: Reverse-Osmosis Membranes by Plasma Polymerization. NASA Tech Brief B72-10710; see also Science, vol. 179, p. 500, 1973.

Notes:

1. It is anticipated that a variety of polymerized chloro-, fluoro-, or chlorofluorohydrocarbons would have equivalent hydrophobic properties.
2. No additionl documentation is available. Specific questions, however, may be directed to:
   Technology Utilization Officer
   Ames Research Center
   Moffett Field, California 94035
   Reference: B73-10507

(continued overleaf)

Patent status:

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

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