Materials

Using Ozone To Clean and Passivate Oxygen-Handling Hardware

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A proposed method of cleaning, passivating, and verifying the cleanliness of oxygen-handling hardware would extend the established art of cleaning by use of ozone. As used here, “cleaning” signifies ridding all exposed surfaces of combustible (in particular, carbon-based) contaminants. The method calls for exposing the surfaces of the hardware to ozone while monitoring the ozone effluent for carbon dioxide. The ozone would passivate the hardware while oxidizing carbon-based residues, converting the carbon in them to carbon dioxide. The exposure to ozone would be continued until no more carbon dioxide was detected, signifying that cleaning and passivation were complete.

This work was done by Paul Torrance of Johnson Space Center and Paul Biesinger of Science Applications International Corp. For further information, contact the Johnson Commercial Technology Office at (281) 483-3809. MSC-23290-1

Metal Standards for Waveguide Characterization of Materials

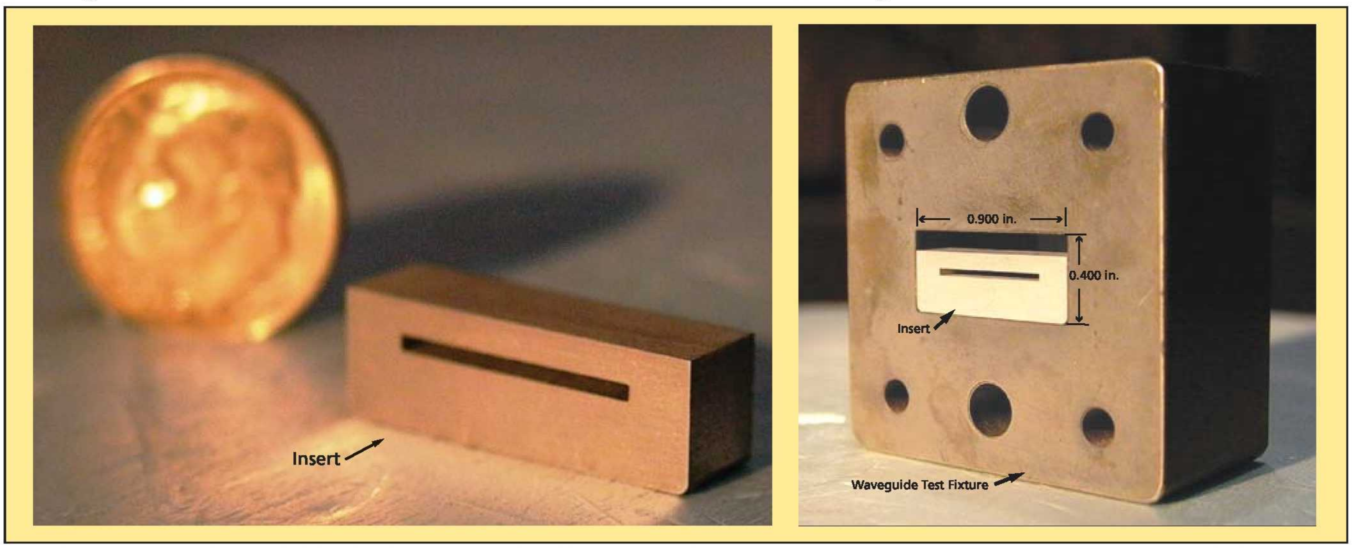
Metal waveguide inserts can be tailored to have known scattering parameters.

John H. Glenn Research Center, Cleveland, Ohio

Rectangular-waveguide inserts that are made of non-ferromagnetic metals and are sized and shaped to function as notch filters have been conceived as reference standards for use in the rectangular-waveguide method of characterizing materials with respect to such constitutive electromagnetic properties as permittivity and permeability. Such standards are needed for determining the accuracy of measurements used in the method, as described below.

In this method, a specimen of a material to be characterized is cut to a prescribed size and shape and inserted in a rectangular-waveguide test fixture, wherein the specimen is irradiated with a known source signal and detectors are used to measure the signals reflected by, and transmitted through, the specimen. Scattering parameters [also known as “*S*” parameters (S_{11}, S_{12}, S_{21}, and S_{22})] are computed from ratios between the transmitted and reflected signals and the source signal. Then the permeability and permittivity of the specimen material are derived from the scattering parameters. Theoretically, the technique for calculating the permeability and permittivity from the scattering parameters is exact, but the accuracy of the results depends on the accuracy of the measurements from which the scattering parameters are obtained. To determine whether the measurements are accurate, it is necessary to perform comparable measurements on reference standards, which are essentially specimens that have known scattering parameters.

To be most useful, reference standards should provide the full range of scattering-parameter values that can be obtained from material specimens. Specifically, measurements of the back-scattering parameter (S_{11}) from no reflection to total reflection and of the forward-transmission parameter (S_{21}) from no transmission to total transmission are needed. A reference standard



The **Metal Rectangular-Waveguide Insert** is sized and shaped to fit the waveguide cross-section and to act as a band-stop filter having a notch frequency of about 9 GHz. The particular waveguide cross sectional dimensions, known in the industry as “WR-90,” are for a nominal frequency range of 8.2 to 12.4 GHz.

that functions as a notch (band-stop) filter can satisfy this need because as the signal frequency is varied across the frequency range for which the filter is designed, the scattering parameters vary over the ranges of values between the extremes of total reflection and total transmission.

A notch-filter reference standard in the form of a rectangular-waveguide insert that has a size and shape similar to that of a material specimen is advantageous because the measurement configuration used for the reference standard can be the same as that for a material specimen. Typically a specimen is a block of material that fills a waveguide cross-section but occupies only a small fraction of the length of the waveguide. A reference standard of the present type (see figure) is a metal block that fills part of a waveguide cross section and contains a slot, the long dimension of which can be chosen to tailor the notch frequency to a desired value. The scattering parameters and notch frequency can be estimated with high accuracy by use of commercially available electromagnetic-field-simulating software. The block can be fabricated to the requisite precision by wire electrical-discharge machining. In use, the accuracy of measurements is determined by comparison of (1) the scattering parameters calculated from the measurements with (2) the scattering parameters calculated by the aforementioned software.

This work was done by Kevin M. Lambert and Carol L. Kory of Analex Corp. for Glenn Research Center. Further information is contained in a TSP (see page 1).

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Innovative Partnerships Office, Attn: Steve Fedor, Mail Stop 4–8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-18137-1.

Two-Piece Screens for Decontaminating Granular Material

These are more effective than are single-piece screens.

Marshall Space Flight Center, Alabama

Two-piece screens have been designed specifically for use in filtering a granular material to remove contaminant particles that are significantly wider or longer than are the desired granules. In the original application for which the two-piece screens were conceived, the granular material is ammonium perchlorate and the contaminant particles tend to be wires and other relatively long, rigid strands. The basic design of the two-piece screens can be adapted to other granular materials and contaminants by modifying critical dimensions to accommodate different grain and contaminant-particle sizes.

A two-piece screen of this type consists mainly of (1) a top flat plate perforated with circular holes arranged in a hexagonal pattern and (2) a bottom plate that is also perforated with circular holes (but not in a pure hexagonal pattern) and is folded into an accordion structure. Fabrication of the bottom plate begins with drilling circular holes into a flat plate in a hexagonal pattern that is interrupted, at regular intervals, by parallel gaps. The plate is then folded into the accordion structure along the gaps. Because the folds are along the gaps, there are no holes at the peaks and valleys of the accordion screen. The top flat plate and the bottom accordion plate are secured within a metal frame. The resulting two-piece screen is placed at the bottom opening of a feed hopper containing the granular material to be filtered.

Tests have shown that such long, rigid contaminant strands as wires readily can pass through a filter consisting of the flat screen alone and that the addition of the accordion screen below the flat screen greatly increases the effectiveness of removal of wires and other contaminant strands. Part of the reason for increased effectiveness is in the presentation of the contaminant to the filter surface. Testing has shown that wire type contamination will readily align itself parallel to the material direction flow. Since this direction of flow is nearly always perpendicular to the filter surface holes, the contamination is automatically aligned to pass through. The two-filter configuration reduces the likelihood that a given contaminant strand will be aligned with the flow of material by eliminating the perpendicular presentation angle. Thus, for wires of a certain diameter, a two-piece screen is 20 percent more effective than is the corresponding flat perforated plate alone, even if the holes in the flat plate are narrower.

An accordion screen alone is similarly effective in catching contaminants, but lumps of agglomerated granules of the desired material often collect in the valleys and clog the screen. The addition of a flat screen above the accordion screen prevents clogging of the accordion screen. Flat wire screens have often been used to remove contaminants from granular materials, and are about as effective as are the corresponding perforated flat plates used alone.

This work was done by Douglas Backes, Clay Poulter, Max Godfrey, Melinda Dutton, and Dennis Tolman of Alliant Techsystems Inc. for Marshall Space Flight Center. For more information, contact Sammy Nabors, MSFC Commercialization Assistance Lead, at sammy.a.nabors@nasa.gov. Refer to MFS-32496-1