NASA TECH BRIEF

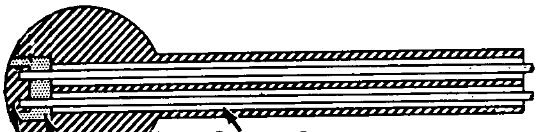
Plasma Conductivity Gage

The problem:

To measure the rapidly varying conductivity of plasmas or the highly ionized gases typically encountered in explosive-shock waves.

The solution:

A gage which permits determination of stagnation conductivity from measurement of the shunt impedance presented by the plasma between the inner and outer conductors of a segment of a coaxial transmission line.



How it's done:

The outer shields of two coaxial cables are stripped down to the dielectric and then inserted through holes bored in the stainless steel gage body (see fig.). The exposed ends of the copper conductors of each coaxial cable are passed through holes in a boron nitride cup which is mounted in the end of the gage and soldered to a stainless steel insert which is then pressed into the boron nitride cup. The conducting path is thus confined to the area between the insert and the body of the gage, with the boron nitride acting as an insulator. The entire assembly, especially the spherical end, is brought to a high degree of polish.

A radio frequency voltage on the order of 50 to 100 MHz is applied to one end of the coaxial cable transmission line, and the voltage at the other end of the line is measured. Thus, the plasma conductivity gage consists essentially of a folded coaxial cable with the plasma acting as a shorting path between the inner and outer conductors; the attenuation of the rf applied signal is proportional to the shunt impedance offered by the plasma which, in turn, is related to the plasma conductivity. Because the high frequency current penetrates only a small distance into the plasma, most of the current flow in the plasma is confined to a skin depth which is related to the frequency of the supplied signal, the magnetic permeability of space, and the plasma conductivity. The skin depth is typically a few tenths of a millimeter, and thus the gage measures only the stagnation conductivity at the probe-plasma interface.

Notes:

1. The sperical end of the gage need not be very large; 1/4-in. to 7/16-in. diameters have been found satisfactory.
2. The response of the gage makes possible its use in shock-tube work and research on explosive propagation.
3. Requests for further information may be directed to:

   Technology Utilization Officer
   Ames Research Center
   Moffett Field, California 94035
   Reference: TSP70-10510

Patent status:

No patent action is contemplated by NASA.

Source: S. P. Gill of
Stanford Research Institute
under contract to
Ames Research Center
(ARC-10147)

Category 01,03