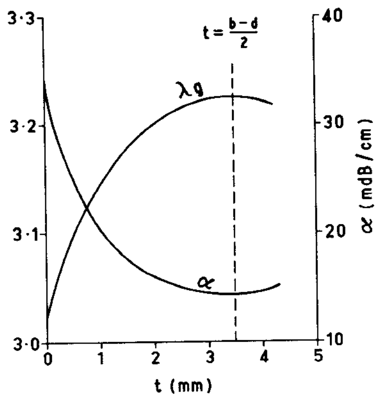

Fig. 2. The effects on α and λ_g of the composite guide of separating the sample from the broad wall by distance t, for a typical sample of $\epsilon = 3 - j0.02$, 1/8 in. thick, measured at 10 GHz, in WG 16 guide.

The computer program, written in Basic, is not claimed to have been optimized for the speed of approach to the root (Newton's method is used to approach the solution along the direction of the steepest descent). This program is available on request.

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The Impedance and Scattering Properties of a Perfectly Conducting Strip Above a Plane Surface-Wave System

JOHN BROWN

***Abstract*—Gillespie and Kilburg have postulated that the fraction of the incident surface-wave power radiated by a conducting strip does not exceed 0.5. This result is shown to be a consequence of the representation of the strip by a shunt impedance.**

With the notation used by Gillespie and Kilburg [1], the fraction of the incident power radiated by the strip is

$$P_{\text{rad}} = \text{Re}\,|1 + \Gamma|^2/\bar{Z}.$$

From [1, eq. (4)],

$$\Gamma = -1/(1 + 2\bar{Z}) = -\bar{Y}/(2 + \bar{Y})$$

where $\bar{Y} = 1/\bar{Z}$. Hence

$$P_{\text{rad}} = \text{Re}\,4\bar{Y}/|2 + \bar{Y}|^2 = \frac{4g}{(2+g)^2 + b^2}$$

when $\bar{Y} = g + jb$.

The maximum value of P_{rad} is seen to occur when $g = 2$ and $b = 0$ and to have the value

$$P_{\text{rad,max}} = 0.5$$

as postulated.

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Comments on "Measured Noise Temperature Versus Theoretical Electron Temperature for Gas Discharge Noise Sources"

RONALD E. GUENTZLER

***Abstract*—Previously published microwave noise temperatures from wall-contained argon discharges at 200 mA dc are compared with the electron temperatures predicted by von Engel and Steenbeck. A good agreement between data and theory results if the ionization efficiency is modified to account for stepwise ionization.**

In the above paper,[1] Olson presented a comprehensive study of measured microwave noise temperatures of commercial-gas discharge noise sources. A poor correlation existed between the theoretical electron temperatures as predicted by von Engel and Steenbeck [1, p. 242] and most of the measured noise temperatures. The data were from both wall-contained and constricted discharges.

While studying Olson's figure 2,[1] it became apparent that there was a definite trend in the data from the wall-contained discharges (points 1, 7, and 11–16). This trend was reinforced when the wall-contained data published by Denson and Halford [2, fig. 2] were plotted along with Olson's data. Although all the wall-contained data disagreed with the theoretical curve, they yielded a least squares fit with $\sigma = 1.25$ percent (0.05 dB).

Further investigation of the wall-contained data revealed that if the von Engel and Steenbeck constant c were multiplied by 2, the measured noise temperatures would fit the modified von Engel and Steenbeck curve with $\sigma = 1.75$ percent (0.07 dB), with the furthest point being only 3.5 percent (0.14 dB) in error. This is shown in Fig. 1. (Although the original Olson data points 8 and 9 fall in the area covered in Fig. 1 they are from constricted discharges and are not shown here.)

The von Engel and Steenbeck constant c is obtained from the formula [1, p. 242]

$$c = [aV_i^{1/2}/k^+p]^{1/2}$$

where a is the ionization efficiency, V_i is the ionization potential, k^+ is the positive ion mobility, and p is the pressure.

Traditionally, c (and thus the theoretical electron temperature) was calculated using a value of a appropriate for *direct ionization* by electron impact; however, *stepwise ionization* takes place at the pressures and currents used in the tubes studied [1, p. 244], [3, p. 29]. The excited atoms have a larger ionization cross section than ground-state atoms and can be ionized by the more numerous lower energy electrons; therefore, the ionization efficiency a can be 4 times greater than the value used under the assumption of direct ioniza-

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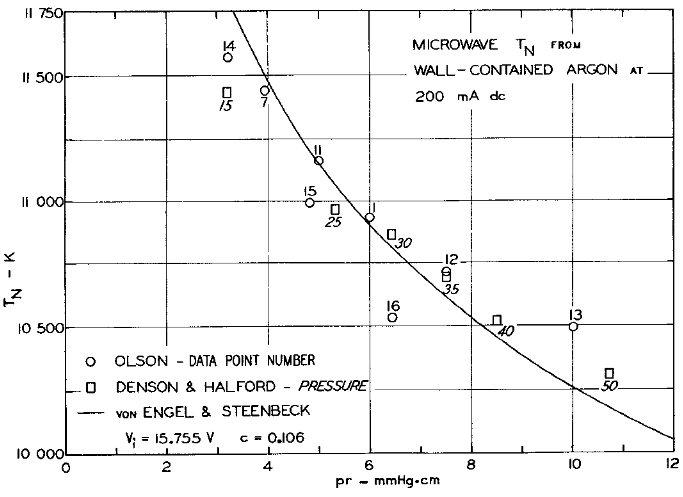

Fig. 1. Measured microwave noise temperature T_N of wall-contained Ar discharges at 200 mA dc versus *pr* (pressure–radius) product compared with the modified (c = 0.106) von Engel and Steenbeck theoretical electron temperature. Circles represent Olson's data points 1, 7, and 11–16. Squares represent Denson and Halford's values from 0.21-cm-inner-radius tubes at the pressures indicated.

tion only, and the theoretical curve will shift to the left.

At present, an accurate calculation of a or c from theoretical considerations does not appear possible because the ionization cross sections for excited states in argon are not known. However, the theoretical determination might be possible in the near future because progress is being made in determining excited-state ionization cross sections [3, p. 29], [4, p. 30], [5, p. 119].

The constant c was multiplied by 2.00 to obtain the curve plotted in Fig. 1; a better fit would have been obtained if a multiplier of 2.07 had been used at 200 mA dc. At 125 mA dc, the average multiplier for c was found to be 1.40; at 150 mA dc, 1.63; and at 250 mA dc, 2.43. These multipliers are less accurate than the values at 200 mA dc because less data were available. However, they were included to show that the multiplier is current dependent and to give an approximate idea of its dependence. The range of validity of the multipliers is presently unknown. The only firm constraint is that the discharge must be wall-contained.

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Microwave Dielectric Properties of an Amorphous Semiconductor System

L. K. WILSON, G. T. O'REILLY, AND D. L. KINSER

Abstract—**Experimental results are presented for the microwave dielectric properties of the glass system $(x)As_2Te_3(1-x)As_2Se_3$ under temperature and compositional variations. The results indicate that the material exhibits potentially useful microwave properties.**

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I. INTRODUCTION

The electrical switching behavior and low-frequency electrical behavior of the As_2Te_3–As_2Se_3 amorphous semiconductor has been studied extensively [1]–[4]. An interesting feature of this system is its moderately high dielectric constant at microwave and infrared frequencies which has been found to be extremely stable over a wide temperature range. These properties indicate a potentially attractive material for such applications as microwave integrated circuits, strip transmission lines, and dielectric windows. In addition, the switching characteristics of amorphous semiconductors could provide new techniques for microwave filters, switches, and limiters.

II. EXPERIMENTAL

Five compositions of the As_2Te_3–As_2Se_3 glass system were prepared with As_2Te_3/As_2Se_3 ratios of 80/20, 70/30, 60/40, 50/50, and 40/60. The glasses were prepared by fusing the appropriate mixture of reagent grade As_2Te_3 and As_2Te_3 in evacuated vycor ampoules at 800°C in a rocking furnace. After heating for 1 h, the molten material was quenched in water. The samples were shaped and polished using standard glass polishing techniques.

Three methods, depending on the frequency range, were used to determine the dielectric properties of the materials. In the frequency range below 550 MHz, the complex admittance of a disk sample positioned at the end of an air-filled coaxial line, was measured using a Thurston bridge. From this measurement, the dielectric constant and loss tangent were calculated.

The same sample configuration was used in the 500–2000-MHz frequency range, but the dielectric measurements were obtained from the VSWR and nullshift using a precision coaxial slotted line.

A slotted waveguide technique was used above 2000 MHz where the line was terminated with the sample and a variable short circuit. The VSWR and position of a voltage minimum were obtained and used with a graphical technique developed by Von Hippel [5] to determine the dielectric constant and loss tangent of the sample. The results obtained at overlapping frequencies for the three techniques were in excellent agreement.

For variable temperature studies, the sample holding fixture was placed in an environmental chamber and by the methods described above, the dielectric constant and loss tangent were obtained.

III. RESULTS AND DISCUSSIONS

The dielectric constant and loss tangent for the various compositions at 300 K remained constant within 5 percent over the frequency range 0.5–18 GHz. The values obtained are given in Table