Conclusions

From Tables 1 and 2 it follows that a good ablative must satisfy the following requirements from chemical considerations: a) it should have a high carbon content, b) the percentage of oxygen should be lower in order to minimize the formation of CO or CO_2 and thus conserve carbon in the solid-state, c) since C═C and C≡C have higher bond energy, a larger percentage of these in the polymer chain would yield a good ablative, d) more of C—H bonds would be desirable since C—H bond is very weak and the rupture of the bond would yield hydrogen which has got a high specific heat, and e) the formation of low molecular weight gases on decomposition is desirable for getting larger concentration of pores per unit volume.

The aforementioned ideas, particularly c and e, are verified for the case of pyrolysis of phenolic resin. The composition of the gaseous products on pyrolysis at various temperatures has been reported by Rindal, Flood and Kendall[7] which confirms the belief that weaker bonds will break first on pyrolysis.

It should be noted that in the above analysis, the relative strength of the bonds has been assessed on the basis of given values of bond energy which refer to gaseous components of the reaction. In the present case, pyrolysis of solid into gaseous products is considered and hence the thermochemistry should involve heats of sublimation of certain species. It appears that the relative bond strengths would be unaffected even if this factor were taken into account and the postulated basis of the mechanism of pyrolysis remains intact.

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Local Thermal Equilibrium in a Transient Arc

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EXPERIMENTS have been conducted upon a 1-cm-diam, 14-cm-length, coaxial cascade argon arc to obtain information on equilibrium during the dynamic response to an applied (positive) voltage pulse. Tests were carried out at pressure levels of 510, 820, and 1120 torr. The arc was operated at initial steady-state currents of 195 amp, 180 amp, and 170 amp, at the respective pressures. The positive voltage pulse resulted in final steady-state current levels about 40 amp larger than initial values. Current rise times were about 400 μsec at all pressure levels; the applied voltage rise time was about 50 μsec. Argon mass flow rate was 0.1 g/s.

Arc radiation data were obtained through the use of an optical system (Fig. 1) containing a high-speed rotating mirror apparatus whose spatial positioning was synchronized with respect to the initiation of the voltage pulse. Data acquisition times were 5 μsec. The 4158.6 ArI line and the adjacent continuum radiation at 4143 Å were simultaneously monitored in the initial steady state and at 15, 30, 100, 200, and 1500 μsec following application

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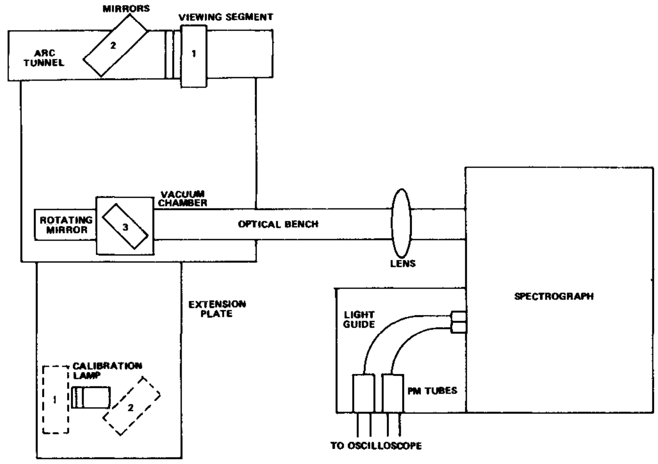

Fig. 1 Optical system.

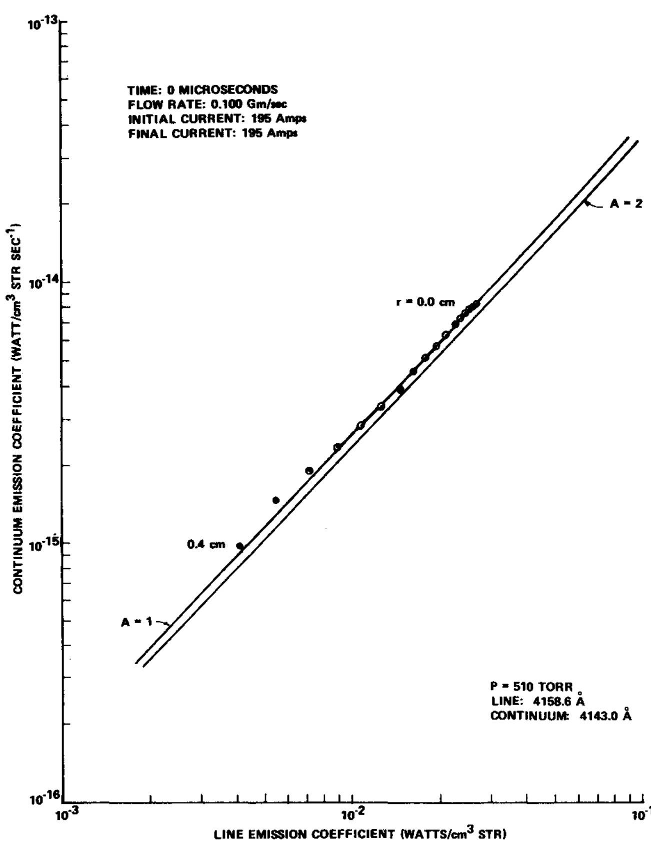

Fig. 2 Emission coefficients, initial steady state.

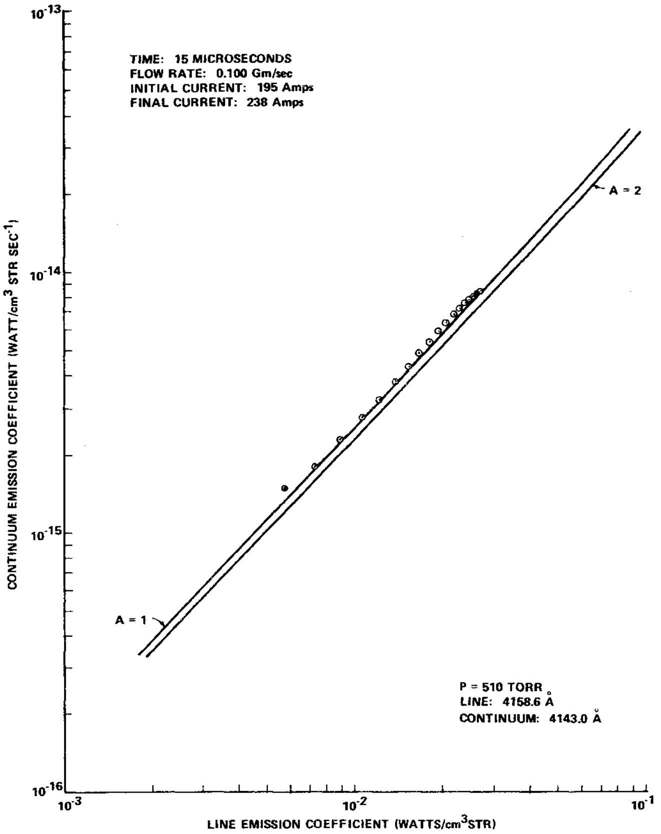

Fig. 3 Emission coefficients, 15μsec into transient.

of the pulse. Information on equilibrium was obtained through comparison of experimental and theoretical emission coefficients.[1,2] [In the computations,[2] $A = 1, 2$ (where A is the ratio of the electron temperature to the heavy particle temperature) were employed.] The gaunt factor in the equation for continuum radiation was determined in the initial steady state from a best fit with the corresponding line radiation. The values of the gaunt factor so obtained were 1.63 at 820 and 1120 torr, and 1.80 at 510 torr. In Ref. 3, at the wavelength of interest, at arc temperatures about 12,000 K, and for pressure levels of 760 and 1520 torr, a value of 1.80 was obtained. In Ref. 4, at atmospheric pressure, at a temperature of 12,000 K, the gaunt factor was found to be about 1.4 at the wavelength of interest.

In Figs. 2 and 3 are shown curves of the experimental and theoretical continuum and line emission coefficients for the initial steady state and 15 μsec into the transient, respectively; pressure level is 510 torr. Such results have indicated the arc to be in local thermal equilibrium down to at least the $3P_6$ level. The result is probably strongly influenced by the relatively long rise time of the applied voltage pulse. Continuous monitoring of the dynamic behavior of the radiation at a given chordwise station has shown a monotonic increase in intensity with time following initiation of the transient. Experiments on rapidly (in the $n$sec–μsec range) crowbarred atmospheric argon arcs[5-7] have indicated an initial increase in arc radiation for times of the order of 100 $n$sec; these increases appear to be related to nonequilibrium distributions in the bound and free energy levels.

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Variable Energy Blast Wave Measurements

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Introduction

THE instantaneous input of a large quantity of energy in an infinitesimally small volume of a gaseous medium produces a strong shock wave front with a flowfield as described by the classical blast wave analysis. Such blast waves have been analyzed by several authors.[1-4] More recently, treatment of the classical blast wave has been extended[5,6] from the classical instantaneous energy addition to the case of injection of energy as a given function of time. Some of the latter work[5] was done in connection with interest in spark discharges in which energy transfer at a rate proportional to time was considered. More generally, in connection with detonations, a variable rate of energy input proportional to time to a constant exponent (t^{β}) was considered.[6] In the more general treatment, $\beta = 0$ would represent the classical case of instantaneous energy input, $\beta = 1$, the energy input proportional to time, and β equal to other values to possibly be employed to simulate certain detonation conditions. The purpose of this Note is to report on measurements of parameters for the case of variable energy input blast waves and to show a comparison of the measurements with the predictions of the available theory.

Apparatus

A low inductance exploding wire circuit was employed so that the energy stored in a large capacitor (14.7 μfd/20 KV Sangamo) could be discharged in an "optimum" fashion[7] with energy transferred to the wire in a single pulse with no oscillation of current and voltage and no dwell time and restrike. A noninductive current shunt (T and M Co.) was used to measure current as a function of time, and the voltage across the wire was measured with a P-6015 Tektronix High Voltage Probe.

Schlieren photographs were taken with an ultra-high speed framing camera (Beckman-Whitley no. 330) capable of up to 2×10^6 frames/sec. The field of view was $\sim 2\frac{1}{2}$ in. in diameter. The wire was exploded at ambient conditions. Number 26 gauge silver wire extending $1\frac{1}{2}$ in. in length between terminals was

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