The effect of Impurities on the Boron Trichloride Catalyzed Deposition of Pyrolytic Graphite

ABSTRACT

The addition of small amounts of boron trichloride to neutral gas is known to enhance the deposition rate and also improve the physical properties of the deposited pyrolytic graphite. The magnitude of this catalytic effect is known to vary with deposition conditions; but experiments performed under apparently identical conditions have often given different results. It was postulated that these fluctuations are due to small changes in the composition of the feed stock gases, which change the deposition kinetics.

A large number of experiments would have had to be performed to examine fully the effects of the impurities in natural gas and boron trichloride on the deposition rate. A system of 9 instead of 14 variables was obtained by holding temperature, flow and geometry constant and showing that argon and nitrogen have little or no first order effect. A nine dimensional matrix consisting of 512 experiments was utilized to completely determine all of the interactions among the impurities and gases at two levels.

A new method was used to determine each datum point, as a result of the large number of experiments needed. The formation and growth of soot particles, suspended in the gas mixture, was monitored by observing the incandescent particles (1500°C), with a photoelectronic device. The data correlated well with standard deposition runs. The method was shown to be quick and accurate.

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The higher hydrocarbon gases in natural gas have an effect nearly comparable to that of boron trichloride. The effect is almost doubled, with both boron trichloride and higher hydrocarbon gases present. In kinetically controlled systems, the deposition rate is altered by the impurity concentration, while in diffusion controlled systems the impurities have little effect.

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