

Fullerene production by carbon arc method in various gases

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Fullerene is synthesized by a carbon arc discharge ignited in various ambient gases (He, Ne, Ar, Kr, H₂, CH₄, N₂, O₂, CO₂). Fullerene yields are 16% for He, 7% for Ne, O₂ and CO₂, and lower than 1% for other gases. Fullerene production rates are about 30 mg/min for He, about 25 mg/min for CO₂, about 15 mg/min for O₂, and lower than 1 mg/min for other gases. On the other hand, the arc plasma is spectroscopically diagnosed. As a result, it is found that the fullerene is efficiently produced when the intensity of C₂ molecule radiated from the plasma is strong.

1. INTRODUCTION

Fullerene is mainly produced by a dc carbon arc method. He gas is mostly used as ambient gas. It is reported that fullerene yields in Ar and N₂ ambient gases are lower than that in He gas [1][2]. It is also reported that in the case of CH₄ gas, only tar is synthesized [3]. To reveal the mechanism of fullerene formation process and to improve the fullerene productivity, it is important to clarify the influence of ambient gases on the productivity and to know the relation between plasma conditions and the productivity.

In this paper, fullerene is synthesized in various rare gases (He, Ne, Ar, Kr) and polyatomic gases (H₂, CH₄, N₂, O₂, CO₂). Then raw soot production rate, fullerene yield, and fullerene production rate are obtained as a function of molecular weight of gas. Meanwhile, the arc plasma is spectroscopically diagnosed. From the relation between the fullerene productivity and the intensities of radiation spectra, the plasma condition for efficient fullerene synthesis is discussed.

2. CARBON ARC APPARATUS AND EXPERIMENTAL CONDITIONS

Figure 1 shows a carbon arc apparatus for synthesizing fullerene [4] and a system for measuring intensities of spectra radiated from the

arc plasma. Carbon arc was ignited in a vacuum chamber (SUS304, 200 ϕ \times 300) with a water cooled inner jacket (SUS304, 135 ϕ \times 200). Observing an image of the arc magnified on a screen, electrode gap length was kept constant during the arc burning.

For the ambient gas being He, it was found that the fullerene productivity had a maximum

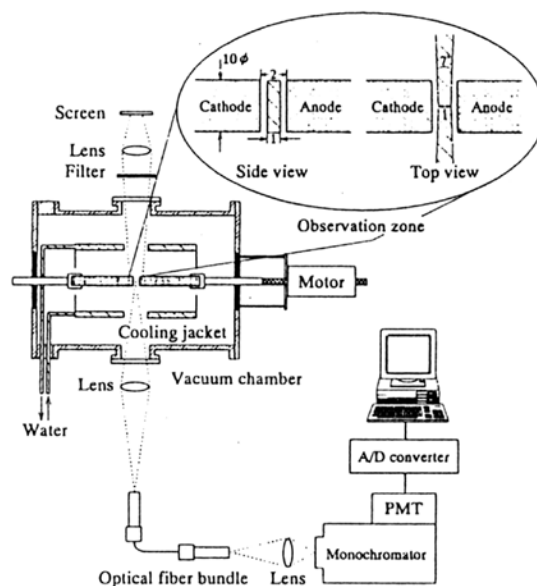


Fig.1. Carbon arc apparatus for synthesizing fullerene and system for measuring radiation spectra from the arc plasma.

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