Optical emission spectroscopy of arc plasma using Ni-Y catalyst for synthesizing single-walled carbon nanotubes

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Arc plasma method enables to synthesize high-crystalline single-walled carbon nanotubes (SWNTs) in large-scale with short-time [1]. However, growth mechanism of SWNTs with arc plasma has not been clarified. In this study, we have focused on the species in arc plasma, and diagnose them using optical emission spectroscopy.

Figure 1 shows experimental setup. An anode carbon electrode (\(\phi\) 6mm) including Ni (4.2at\%) - Y (1.0at\%) as a catalyst and a cathode carbon electrode (\(\phi\) 10mm) were settled in horizontally-facing configuration. Processing gas (He) was introduced at 13.3kPa. Arc plasma was generated by applying DC 50-110A to electrodes. The light emitting from arc plasma was detected by multi-channel spectrometer.

Figure 2 shows the emission intensity ratio of C\(_2\) radical to Ni and Y, and crystallinities of SWNTs (G/D ratio). The intensity ratio at 50 to 90A were approximately 1, while that at 110 A was \(~7\). These results indicates that intensity of catalysts become higher when SWNTs with high crystallinity are synthesized.


![Fig. 1. Experimental setup](image1.png)

![Fig. 2. Intensity and G/D ratio](image2.png)