ELSEVIER

Physica B 323 (2002) 287–289

PHYSICA B

www.elsevier.com/locate/physb

Transformation of graphite into multi-walled carbon nanotubes by AC torch-arc

H. Takikawa[a,*], M. Kato[a], Y. Hibi[a], T. Sakakibara[a], T. Tahara[b], S. Itoh[c]

[a] *Department of Electrical and Electronic Engineering, Toyohashi University of Technology, Tempaku, Toyohashi, Aichi 441-8580, Japan*

[b] *Fuji Research Laboratory, Tokai Carbon Co. Ltd., Oyama, Shizuoka 410-1431, Japan*

[c] *Product Development Center, Futaba Corporation, Chosei, Chiba 299-4395, Japan*

Abstract

In the AC torch-arc method, multi-walled carbon nanotubes (MWCNTs) are obtained in arc spot crater, where the substrate surface is transformed from graphite to MWCNTs. The radius of the arc spot crater was observed as a function of process parameters and the thickness of the processed layer at the arc spot crater was microscopically observed. The large processed radius was obtained at a higher arc current and lower flow rate. The thicker layer was obtained at a shorter gap. Numerous MWCNTs were observed in the processed layer at a higher arc current.

PACS: 81.05.Tp; 52.75.Rx; 52.80.Mg; 81.10.Bk

Keywords: Multi-walled carbon nanotubes; Torch arc; Open air; Transformation; Graphite surface; Alternate current

1. Introduction

In the conventional carbon arc method in a closed low-pressure chamber, multi-walled carbon nanotubes (MWCNTs) are obtained in the soft-core of the cathode deposit evaporated and transferred from the graphite anode [1,2]. In the torch-arc method, the graphite surface is transformed to a MWCNT surface by striking the arc to the graphite surface [3,4] so that the deposition of carbon soot onto one electrode evaporated from the other electrode is unnecessary.

In AC torch-arc method, the transformation of graphite to MWCNT is observed in the arc spot crater on a graphite substrate. The arc spot crater and quantity of MWCNTs are considered to depend on process conditions. In the present study, by changing the process parameters, the size of the arc spot crater was measured. The thickness of the processed layer on the graphite substrate and the presence of MWCNT were microscopically observed in a cross section of the arc spot crater.

2. Experimental details

The experimental setup of torch-arc method was presented previously [3,4]. The arc torch for conventional tungsten-electrode-inert-gas (TIG) welding was used, except that the tungsten (W)

*Corresponding author. Tel./fax: +81-532-44-6728.
E-mail address: takikawa@eee.tut.ac.jp (H. Takikawa).

0921-4526/02/$ - see front matter
PII: S0921-4526(02)01024-4