

New Simple Method of Carbon Nanotube Fabrication Using Welding Torch

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Abstract. A new, simple method of carbon nanotube fabrication was developed. The method employed a tungsten-electrode-inert-gas (TIG) welding arc torch, with a graphite electrode used instead of a conventional tungsten electrode in order to prevent contamination of the tungsten vapor and droplets. The substrates used as counterelectrodes for the torch arc were pure graphite and catalyst (Ni, Y)-mixed graphite. The torch arc was operated in open air with both DC and AC modes. Nanotubed surfaces were obtained on catalyst-mixed graphite with DC and AC modes, and on pure graphite with the AC mode.

INTRODUCTION

Carbon nanotubes were first discovered in the cathode deposit of low-pressure arc producing fullerene [1]. Since then, various investigations have been carried out in low-pressure arcs with a homoelectrode system of graphite (C) cathode and C anode [2-5]. The authors have examined carbon nanotube fabrication with a low-pressure heteroelectrode arc (C-molybdenum (Mo) electrode system) [6], cathodic vacuum arc with inert anode [7,8], running and jumping arcs under a magnetic field [9,10], and a catalytic heteroelectrode arc in low pressure [11]. In these experiments, the arc was discharged for 1-2 s. These experiments produced the following results. When C is used for the cathode material, the nanotubes are formed at the cathode spot, regardless of anode material, ambient gas species, and pressure. Also, the nanotubes do not readily form at the anode spot of pure C anode electrodes. However, if the C anode material contains a metal catalyst, the nanotubes can be formed at the anode spot.

These results indicate that if a catalyst-mixed C anode is used, nanotubes can be produced on the anode surface even in open air. Based on this, the present study provides a new, simple method for preparing nanotubes, using a welding arc torch operated in an open-air environment.