

Carbon deposition on the stainless steels substrates using pulsed plasma

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We have developed a generic method for carbon deposition method for any substrates from methane pulsed plasma. The generic method has been developed for carbon deposition on the stainless steels substrates using pulsed methane plasma. Pulsed plasma was produced at atmospheric pressure methane gas and room temperatures. Methane plasma was generated using with 25kV, 25kHz pulsed power supply. Discharge current approximately 300 mA. Stainless steels probes hold in the 32mm from the methane plasma. Probes dimensions were $\phi=30\text{mm}$, $h=8\text{mm}$ and 4 mm.

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1. Introduction

Carbon nanotubes have attracted much attention because of their unique structure and properties since they were discovered because of nanocarbon structures represent new type materials with unique mechanical and electrical properties [1-10]. Due to their high aspect ratios, small tip radius of curvature, and different helicity together with high chemical stability and high mechanical strength, carbon nanotubes have been considered as promising materials for semiconductor devices, miniature electronic wires and electron field emission sources in cold cathode flat panel displays, hydrogen storage, the reinforcement of composites with ceramic and polymer matrices, the development of specialized lamps and flat panels, etc [1,3-5]. Nanocarbon structures generally are produced by several techniques like chemical vapor deposition (CVD), laser ablation, electric arc methods [6-8]. It is still a challenge to fabricate carbon nanotubes at atmospheric pressure and low temperature simultaneously [1].

In our early published papers, carbon production method was defined at atmospheric pressure using pulsed plasma in methane media. The conversion of the atmospheric pulsed plasma methane to carbon, our previous papers present very cheap and simple method because of no any vacuum equipment is necessary. We estimated there type produced carbons by pulsed plasma that they were called powder, soft and hard carbon for define [1, 2, 10]

We report a new method for carbon deposition method using high voltage and frequency power supply (25 kV, 25 kHz) at atmospheric pressure and low temperature.

2. Experimental arrangement

The simplified scheme of the deposition system is illustrated in Fig. 1

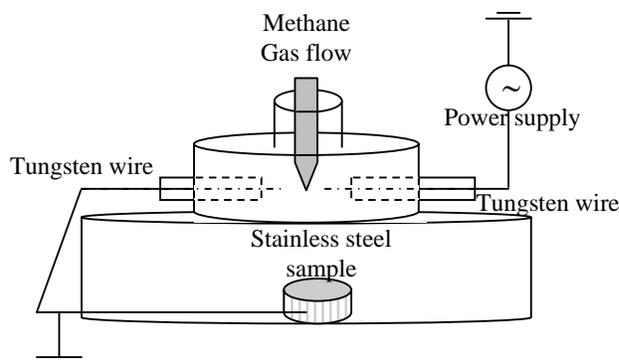


Fig.1. Schematic illustrations of the experimental device

An A.C. high voltage generator operating at 25kV and 25 kHz was used to igniting methane discharge. The discharge was started at atmospheric pressure and room temperature. It was observed that a black carbon quickly formed on the surface of stainless steel substrates since the pulsed methane discharge occurred. After the igniting about 6 minutes, stainless steel substrates were analyzed by SEM. In same time, we were produced three type carbon that reported before. Also, we are collect and analyzed these carbon structures by SEM. Continuously; methane gas was input the discharge device at constant flux. The results of the three type carbons were similar to previous paper's results. This article is shown the carbon deposition process at atmospheric pressure using power supply of 25 kV and 25 kHz.

3. Experimental Results

Methane plasma was generated using with 25kV, 25kHz pulsed power supply. Methane discharges current

approximately 300 mA. Stainless steel probes were held in the 32mm from the methane plasma. Dimensions of stainless steel substrates were $\phi=30\text{mm}$, $h=8\text{mm}$ and 4 mm. Figs.2,3,4 shows SEM image of the deposited carbon films in 10 k \times , 20 k \times and 50 k \times magnifications, respectively.

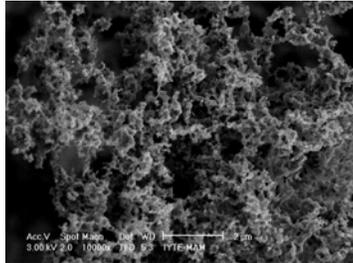


Fig. 2. SEM image of the deposited carbon

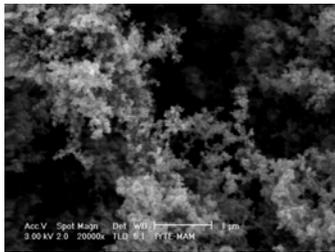


Fig..3 SEM image of the deposited carbon

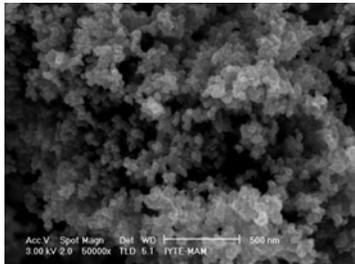


Fig.4. SEM image of the deposited carbon

Fig. 5 shows SEM image of the hard carbon was production during the deposition over the wolfram electrodes.

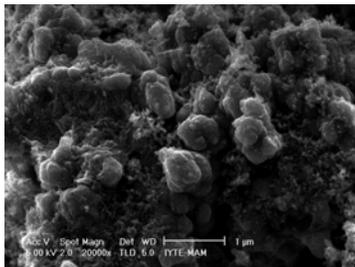


Fig.5. SEM image of the produced hard carbon

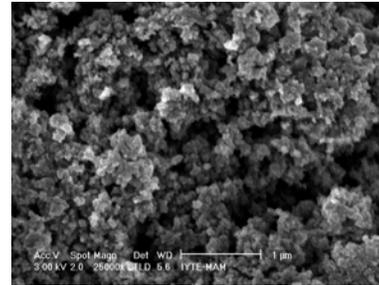


Fig.6. SEM image of the produced soft carbon

4. Results and discussion

In this study, we realized carbon deposition on the stainless steel substrate at atmospheric pressure and room temperatures using pulsed methane plasma. Also, we have successfully synthesized three type carbon structures from methane gas.

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