CVD・PVD Hybrid DLC Coating to Extra Fine Wire by Quadrupole Magnetron Plasmas

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Abstract

It was investigated that characteristics of DLC thin films deposited to extra fine wire by CH_4 gas, Ar gas and CH_4/Ar gas mixtures. It was found that the characteristics of films are change depending on mixture rate of the gases.

Key Words

DLC, Quadrupole magnetron plasmas, CVD・PVD Hybrid Process, Extra Fine Wire

Introduction

We forward this experiment for following two purposes. First target is biocompatibility addition to surface of guide wire in medical field. Second target is making target wire for coating to inner wall of fine canal.

So, this experimental purpose is to deposit DLC thin film that has high hardness, smooth surface and biocompatible to extra fine wire of several hundred micro meters in diameter. We aim at improvement of adhesion and uniformity of film by using quadrupole magnetron plasmas and CVD・PVD hybrid coating method. quadrupole magnetron plasmas was developed by Professor H.Fujiyama and more for optical fiber coating. [1] CVD・PVD hybrid coating method is using by both CVD and PVD method. In this paper, we tried DLC coating to extra fine wire by changing gas mixing ratio of Ar and CH_4.

Experimental

Figure 1 shows electrode holder and electrode structure of the quadrupole magnetron plasmas. Four carbon electrodes (outer diameter ; 4mm) were arranged in the square, and the hole to pass the wire through the center of

square was opened. The four electrodes was applied 60Hz AC power supply. It is same voltage that the electrodes were arranged in the diagonal position. The wire (outer diameter ; 300 μ m , length ; 200mm) was treated mirror finish and caught be apply negative DC voltage. The chamber was twisted by solenoidal coil and the quadrupole magnetron plasmas were generated by 630 Gauss magnetic field.

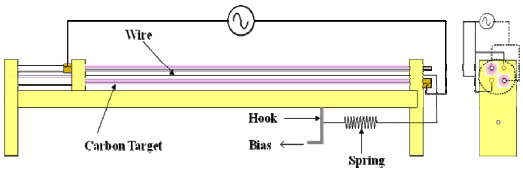

Fig.1 Coating Method for Extra Fine Wire Coating

Table.1 Experimental Condition

Pressure	300[mTorr]	
Gas	CH_4	100[sccm]
	Ar	
Discharge Voltage	280[V]	
Bias Voltage	-100[V]	
Magnetic Field	630[Gauss]	
Deposition Time	30[min.]	

We deposited with this setup while changing gas mixing ratio as needed. In this paper, we report results of films by using PVD method by Ar, CVD method by CH_4 and Hybrid coating method by Ar/CH_4 gas mixture. The experimental condition is shown in Table.1.

Results and Discussions

Figure 2 shows raman spectra of films with hybrid coating system. It was found that DLC was deposited by CH_4: 50sccm, Ar: 50sccm and CH_4: 75, Ar: 25sccm. But it was found that Graphite was deposited by CH_4: 25, Ar: 75sccm.

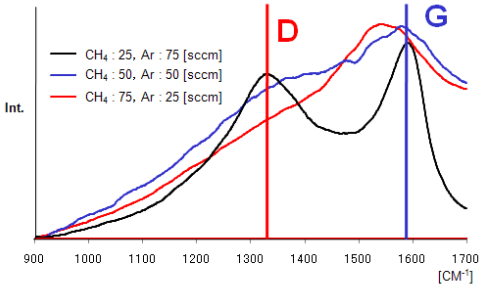

Fig.2 Raman Spectra of Films with Hybrid Coating System

Figure 3 shows SEM image of film with hybrid coating system (CH_4: 50sccm, Ar: 50sccm). It was found that the uniformity of the films with hybrid coating system is higher than the films with CVD and PVD.

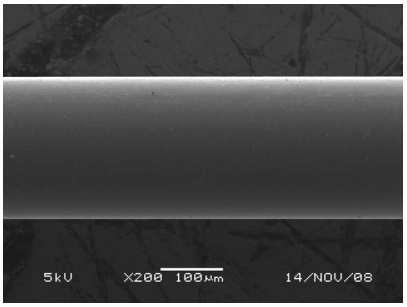

Fig.3 SEM Image of Film with Hybrid Coating System (CH_4: 50sccm, Ar: 50sccm)

Conclusions

It was found that the characteristics of films are change depending on mixture rate of the gases. In this experiment, I think the high uniformity and high adhesion DLC coating method to extra fine wire is an advantage for hybrid coating system over CVD and PVD.

Reference

[1] T. Kashima, Y. Matsuda and H. Fujiyama: *Materials Science & Engineering*, Vol.A139 pp.79-84 (1991).