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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 CH₄ gas, Ar gas and CH₄/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 CH₄.

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 μm, 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.

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.

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.

### 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