

## Inner Wall DLC Coating of Narrow Tubes by Using the 2<sup>nd</sup> Harmonic ECR Micro Plasma

K. Yan<sup>1</sup>, Y. Nitta<sup>3</sup>, T. Nakatani<sup>3</sup>, K. Okamoto<sup>3</sup>,  
M. Shinohara<sup>2</sup> and H. Fujiyama<sup>1\*</sup>

<sup>1</sup>Graduate School of Science and Technology, Nagasaki Univ.,

<sup>2</sup>Faculty of Engineering, Nagasaki Univ.,

<sup>3</sup>Toyo Advanced Technologies Co. Ltd

Nagasaki University, 1-14 Bunkyo, Nagasaki 852-8521, Japan

E-mail: [plasma@nagasaki-u.ac.jp](mailto:plasma@nagasaki-u.ac.jp)

### Abstract

For the inner surface DLC (Diamond Like Carbon) coating of narrow tubes, we have investigated on CVD & PVD hybrid process with the 2nd harmonic electron cyclotron resonance (ECR) plasmas. From the analysis of Raman spectrum, it was confirmed that DLC could be prepared on the substrate.

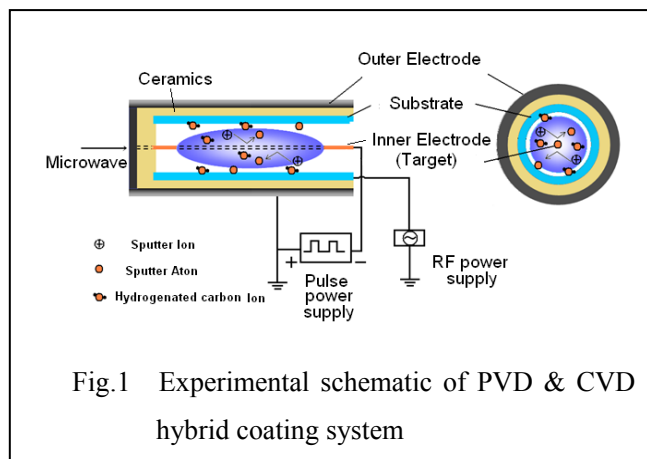
*Keywords:* Micro plasma, ECR, Inner coating, Narrow tube, Hybrid process

### Introduction

For the application to medical and biotechnology field, we are trying to deposit DLC films on an inner wall of narrow tubes with the 2nd harmonic ECR plasma. For the faster deposition, better homogeneity and adhesiveness of the films to the substrate, hybrid process simultaneous using the coaxial sputtering and PECVD was developed. In the present research, we challenged to coat DLC films in an inner wall of narrow tube by using this hybrid process, and analyzed a Raman spectrum of the films.

### Experimental

Figure 1 shows the experimental schematic of developed PECVD & PVD hybrid coating system. The inner electrode is carbon rod target. The outer electrode is electrically grounded. The narrow glass tube was set in contact with the outer electrode. Mixed gas (50%Ar+50%C<sub>2</sub>H<sub>4</sub>) were introduced into



the tube, the operational pressure was 7mTorr. 2.45GHz TEM mode microwave was applied to the inner electrode. Plasma can be generated between the inner and outer electrodes. The CVD process is operated when reactive C<sub>2</sub>H<sub>4</sub> gas is supplied. The coaxial sputtering process is operated when a negative pulse bias voltage is applied to the inner electrode. When the pulse bias voltage was applied in mixed gas, the CVD & PVD hybrid process could be realized simultaneously.

### Results and Discussions

Figure 2 shows the Raman spectrum for the condition of CVD process with RF bias=-30V. The Raman spectrum for the condition of CVD & PVD hybrid process (RF bias =-30V, Pulse bias=-700V) is also shown in Fig.3. From these results, it was found that DLC films could be prepared by the hybrid process.

By comparison with both spectra, it is found that I<sub>D</sub>/I<sub>G</sub> ratio in Fig.3 is larger than that in Fig.2. In fact, sp<sup>3</sup> structure of the films by the present CVD & PVD hybrid process seems to be larger than that prepared by CVD process. Further study is needed to understand the reason why.

### Conclusions

We have developed new method for inner surface DLC coating of narrow tubes by using CVD & PVD hybrid process in the 2nd harmonic ECR plasmas. It was found that DLC film could be prepared by using CVD & PVD hybrid process.

### References

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