3P04

ハイパワーインパルスマグネトロンスパッタリングの イオンエネルギー分布関数の測定

Measurement of ion energy distribution function on high power impulse magnetron sputtering

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1. Introduction

In recent years, diamond-like carbon (DLC) film has attracted attention for a coating of sliding parts of an automobile engine in order to reduce the mechanical friction. DLC has an amorphous structure composed of sp^2 (graphite) and sp^3 (diamond) bonds. Especially, the DLC film including much sp^3 bonds (ta-C) is necessary to realize low friction.[1] High power impulse magnetron sputtering (HiPIMS) is one of the pulsed sputtering methods. In HiPIMS, a high voltage pulse with duration time of several tens μs is applied to the target at low frequency of several hundred Hz. The peak power density is higher than 0.5 kW/cm^2, realizing a high degree of ionization of the sputtered species.[2] In order to control thin-film quality, it is essential to elucidate the ionization process of sputtered species. In this study, we measured ion energy distribution functions (IEDF) of Ar^+ and C^+ with energy-resolved mass spectrometry.

2. Experimental

A negative pulse voltage with frequency of 400 Hz was applied to the carbon target. Applied voltage was increased from 760V to 910V. The pulse width was constant at 8 μs. The Ar gas flow rate was 5 sccm and the pressure was kept at 0.5 Pa. The orifice of mass spectrometer was set at opposite of the target and the distance was 68 mm.

3. Results and discussion

The IEDFs of Ar^+ and C^+ are shown in Fig.1. As shown in Fig.1 (a), the IEDFs of Ar^+ consisted of low and high energy components. The number of low energy Ar^+ around 2 eV decreased and the low energy component spread to about 4 eV. The high energy component drastically increased above 830V. The IEDFs of C^+ consisted of mainly high energy component as shown in Fig.1 (b). The total flux of C^+ increased with no change in ion energy distribution with applied voltage.

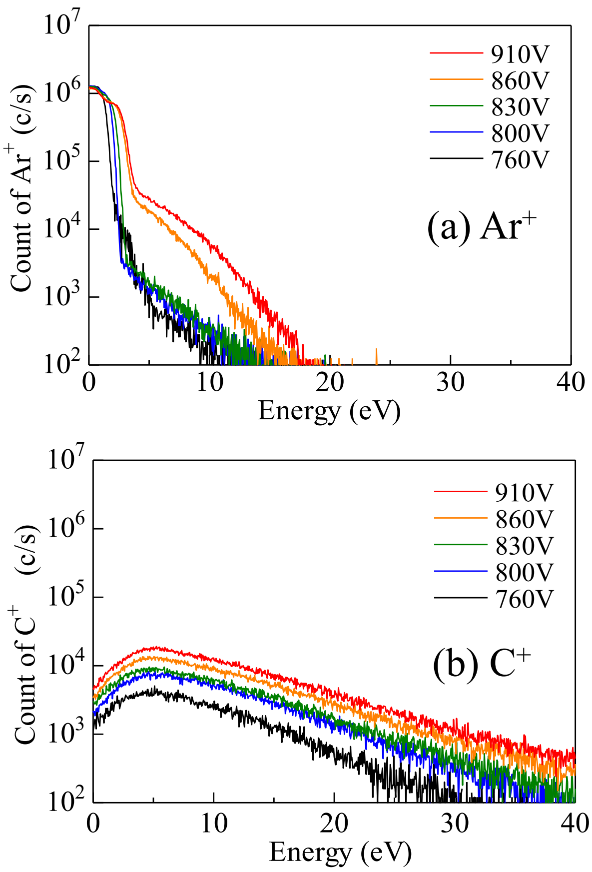

Fig.1 the IEDFs of (a) Ar^+ and (b) C^+.

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[2] J. Bohlmark *et. al.*, J. Vac. Sci. Technol., **23**, (1), 18 (2005).