HYDROGEN INCORPORATION IN TUNGSTEN DEPOSITS GROWING BY DEUTERIUM PLASMA SPUTTERING

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Tungsten is a candidate material for plasma-facing components of a fusion reactor because of low solubility and low sputtering yield for hydrogen isotope. Plasma-facing materials are more or less eroded by plasma-surface interaction and sputtered atoms form re-deposition layers and dust. It is important to understand basic behaviors of hydrogen isotopes with erosion and deposition because hydrogen sorption/desorption on plasma-facing surface affects plasma control. It has been reported by the present authors that a tungsten deposit formed by helium plasma sputtering contained a large amount of hydrogen in addition to helium [1]. This hydrogen was speculated to originate from impurity water vapor during the deposition process. In this study, tungsten deposits were formed by deuterium plasma sputtering and the incorporation of hydrogen was investigated.

Tungsten deposits were formed by sputtering method using deuterium RF plasma where deuterium pressure during sputtering was set at the range from 2Pa to 230Pa. The amount of hydrogen isotope retained in the tungsten deposits was investigated by thermal desorption method. Atomic concentration on tungsten deposits was analyzed by an energy dispersive X-ray equipment.

Figure 1 shows the retention of hydrogen isotopes as (H+D)/W, the ratio of hydrogen to total hydrogen isotope as H/(H+D) and oxygen concentration as a function of deuterium pressure. The retention of hydrogen isotope decreased with increasing deuterium pressure. As total pressure increases, the impinging energy of ions to the growing surface becomes little because of the frequent collision with neutral molecules. Consequently, it is considered that the retention of hydrogen isotope became small. The ratio of hydrogen and oxygen increased with increasing deuterium pressure. This suggests the possibility that the water vapor pressure increases as deuterium pressure increases. It is speculated by the present authors that hydrogen is incorporated in tungsten deposits by an isotope exchange reaction between W-D and H_2O in addition to an adsorption as water vapor.

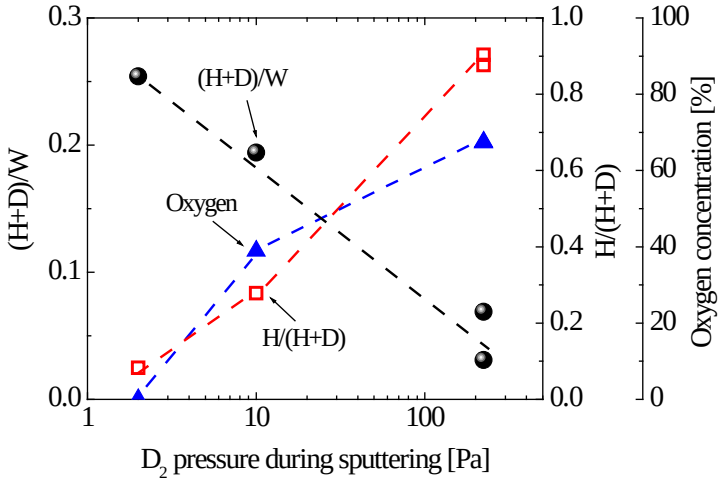

Figure 1: Deuterium pressure dependence of (H+D)/W, H/(H+D) and oxygen concentration in W deposits.

[1] K. Katayama et al., Fusion Eng. and Des., 82, 2007, 1645-1650.