

Hydrogen and helium trapping in tungsten deposition layers formed by RF plasma sputtering (P2-F-82)

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Understanding of tritium behavior in plasma facing materials is an important issue for fusion reactor from viewpoints of fuel control and radiation safety. Tungsten is used as a plasma facing material in the divertor region of ITER. However, investigation of hydrogen isotope behavior in tungsten deposition layer is not sufficient so far. It is also necessary to evaluate an effect of helium on a formation of deposition layer and an accumulation of hydrogen isotopes because helium generated by fusion reaction exists in fusion plasma. In this study, tungsten deposition layers were formed by sputtering method using hydrogen and helium RF plasma. An erosion rate and a deposition rate of tungsten were estimated by weight measurement. Hydrogen and helium retention were investigated by thermal desorption method.

Tungsten deposition was performed using a capacitively-coupled RF plasma device equipped with parallel-plate electrodes. A tungsten target was mounted on one electrode which is supplied with RF power at 200W. Tungsten substrates were mounted on the other electrode which is at ground potential. The plasma discharge was continued for 120 hours where pressure of hydrogen or helium was controlled to be 10 Pa. The amounts of hydrogen and helium released from deposition layers was quantified by a gas chromatograph. The erosion rate of target tungsten under helium plasma was estimated to be 1.8 times larger than that under hydrogen plasma. The deposition rate on tungsten substrate under helium plasma was estimated to be 4.1 times larger than that under hydrogen plasma. Atomic ratio of hydrogen to tungsten in a deposition layer formed by hydrogen plasma was estimated to be 0.17 by heating to 600 oC. From a deposition layer formed by helium plasma, not only helium but also hydrogen was released by heating to 500 oC. Atomic ratios of helium and hydrogen to tungsten were estimated to be 0.080 and 0.075, respectively. The trapped hydrogen is probably impurity hydrogen emitted from a surface of a vacuum chamber to plasma during helium plasma discharge. It was found that tungsten deposition layers formed by RF plasma sputtering can retain a large amount of hydrogen and helium.