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重水素照射および重水素・ヘリウム同時照射時における低放射化フェライト鋼 F82H の
表面形態の変化とスパッタリング率、水素同位体吸蔵に関する研究

**The study of surface morphology, sputtering yield and deuterium retention in reduced activation ferritic martensitic steel (F82H) under simultaneous deuterium and helium irradiation**

薬師寺高輝、Lee Heun Tae、大宅諒、伊庭野健造、上田良夫
K.Yakushiji, H.T. Lee, M.Oya, K.Ibano, Y. Ueda

大阪大学大学院工学研究科
*Graduate School of Engineering, Osaka University*

## 1. Introduction

Reduced Activation Ferritic Martensitic (RAFM) steels have been developed and studied in several countries, and they are presently the leading candidates as structural material in a fusion reactor. To minimize the cost and complexity of building and operating a fusion reactor, it has been suggested that bare RAFM steels be used without any armor materials for the first wall in a fusion reactor. This will lead to direct implantation of hydrogen isotopes and helium impurities in the near surface, and therefore hydrogen isotope retention behavior in RAFM steels in the presence of helium needs to be clarified. The effects of simultaneous irradiation of hydrogen isotopes and He in F82H have so far not been examined in any detail. In this study, we compare surface morphology, sputtering yield and D retention behavior in F82H under D-only and simultaneous D+He irradiation cases, to examine the effect of He.

## 2. Experimental

F82H samples used in this study were cut from "IEA-heat t7" developed/procured by Japanese Atomic Energy Agency. The sample dimensions used in this study was $10\times10\times1$ mm$^3$. D-only irradiation experiments and simultaneous D+He irradiation experiments were performed using the high flux ion beam test device [1] (HiFIT) at Osaka University, with 1 keV extraction voltage. The irradiation experiments were performed at the following temperature: 500 - 818 K. The irradiation fluence was kept constant at $1\times10^{24}$ D/m$^2$. In simultaneous D+He irradiation experiments, He impurity % in the ion beam was estimated to be ~0.5 %. Sputtering yield was estimated from mass loss measurements before and after irradiation experiments. Surface morphology change was observed with SEM. D and He retention in F82H samples was determined by thermal desorption spectroscopy (TDS) following ion irradiation experiments.

## 3. Results

At T ＞ 750 K sputtering yield increases with temperature for both D-only and D+He irradiation experiment. However the sputtering yield for simultaneous D+He irradiation was systematically higher correspondly, from SEM images significant surface morphology change occurred at T ＞ 750 K. A systematic reduction in D retention due to simultaneous D+He irradiation was observed as shown in Fig.1. There appeared to be a monotonic increase in D retention with increasing temperature. As for He retention, a maximum retention amount was observed from sample irradiated at 625 K. At irradiation temperature greater than 625 K, a monotonic decrease in the He retention was observed. It was clear that He results in a systematic decrease in D retention. However D and He retention did not obey similar temperature dependency.

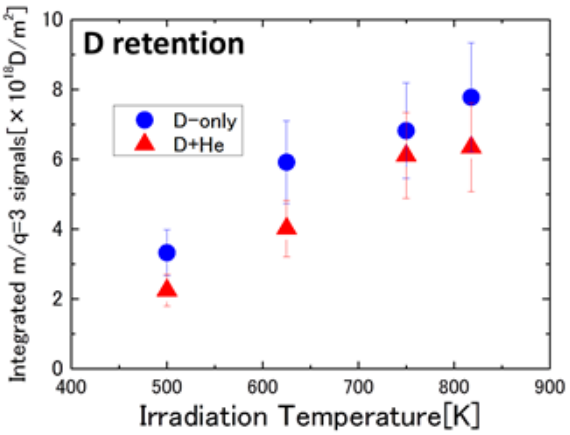


**Fig.1** Deuterium retention in F82H determined from TDS as function of sample irradiation temperature

## References

[1] Ueda Y et al 2002 Fusion Enginnering and Design 61 255