Contribution ID: **182** Type: **not specified**

Influences of fabrication conditions on hydrogen isotope retention in W coatings

Monday, 17 September 2018 11:00 (2 hours)

Low pressure plasma spraying (LPS) and spark plasma sintering (SPS) are attractive techniques to prepare W armor layers on substrate materials. The properties of LPS-W and SPS-W depend on fabrication conditions. In this study, LPS-W and SPS-W layers were prepared on graphite and carbon fiber reinforced carbon composite (CFC) substrates at different temperatures, and D retention after plasma exposure was examined.

LPS-W layers were prepared on graphite tiles (IG-430U) at 1073–1353 K or 1233–1453 K. The coatings were subjected to heat treatment in vacuum or mechanical polishing to remove fine W oxide grains formed by fume condensation. SPS-W layers were prepared on CFC tiles (CX-2002U) at 1773, 1873 and 1973 K. The coating thickness was 1 mm. After removing the substrates by mechanical polishing, the coatings were exposed to D plasma at 373 K in a linear plasma device. The flux and fluence were 5×10^21 m^-2 s^-1 and 2×10^25 m^-2, respectively. The incident ion energy was 80 eV. Contents of D and H were measured using thermal desorption spectrometry at 0.5 K/s.

For all types of coatings, the D retention was in a range of 6–35×10^19 D m^-2. The main desorption peaks appeared at 500–700 K. Fine W oxide grains on LPS-W were successfully removed by heat treatment and polishing. The D retention in the polished samples was slightly higher than that in non-polished ones. The coatings prepared at 1073–1353 K showed smaller D retention than those formed at 1233–1453 K, though columnar grains were more developed in the latter. The D retention in SPS-W was insensitive to the preparation temperature and slightly smaller than that in LPS-W, though the concentration of impurity H was higher. The correlation of D retention with microstructure and surface morphology will be discussed.

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Session Classification: P1

Track Classification: Plasma Facing Components