Polished polycrystalline W has been irradiated at room temperature using high flux deuterium plasma beams with energies ranging from 7 until 98 eV/D. The critical fluence for blistering increased with decreasing the incident energy, and blister rupturing was observed to affect surface morphology and deuterium retention significantly.

**Keywords:** Tungsten, Plasma irradiation, Blistering, Fusion Reactor

1. **Introduction**

Tungsten is one of promising materials for divertor in a fusion reactor, including ITER, where it may be subjected to high flux irradiation of hydrogen with quite low energies (<100 eV), which thus puts forward an urgent requirement to studies on the interactions between tungsten and hydrogen under such low energies and high fluxes conditions.

2. **Experimental**

Polished W samples of 10×10×2 mm and 99.99% pure, manufactured by powder-metallurgy and hot-rolled reduction, were irradiated with the plasma irradiation device at TPL/JAERI that is capable of generating plasma beams up to flux of ~10^{22} ions/m²/s. Irradiations up to fluence of 6×10^{25} D/m² were performed at room temperature under a fixed flux of 1×10^{22} D/m²/s and energies from 7 to 98 eV/D via changing the negative bias applied to sample. The samples were then analyzed with SEM and D₂-calibrated TDS.

3. **Results and discussion**

A typical surface image is shown in Fig.1 after irradiation. Two distinct areas are observed on the surface. One is easy to blister (lower half) while the other hardly (upper half). The former can be connected to the originally smooth area after polishing and the latter to the area with sparse and shallow pits on. The difference may be attributed to crystallographic orientation and surface roughness that often influence sputtering and blistering processes on a surface. In Fig. 2 showed is the critical fluences for blistering and blister rupturing. The increase in the blistering fluence with decreasing the incident energy, especially for energies < 20 eV/D, might be attributed to the oxide layer on the surface acting as either a release barrier or an uptake barrier at different energies. Blister rupturing was observed at a point after blistering, as revealed in TDS measurement, and further verified by the SEM observation. The rupturing limits the retention in W to a quite low and stable level of ~10^{19} D₂/m².

4. **Conclusions**

It became clear that blistering at W occurred at room temperature with its critical fluence increasing with decreasing the incident energy and that retention in W was limited by rupturing of the blisters.