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The Study of Fuzzy Tungsten Production in a Magnetron Source

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Nanostructured W has been studied comprehensively through experiments due to the strong likelihood of W being included as a plasma facing material in future fusion reactors, most notably ITER and DEMO. The nanostructure, more often called fuzz, is produced when He ions of a sufficient energy irradiate a W surface and high pressure He bubbles are formed, with loop punching and W adatom processes being theorised to produce the tendril structure. The accepted values for the conditions required to produce W fuzz formation have been summarised and generally for surface temperatures of between 1000K to 2000K, a He ion energy of ≥ 20eV and a fluence of He ions of at least 2.4 x 10^{24} m^{-2} W fuzz can be formed. Recently the importance of looking at lower flux devices has become more prevalent, particularly the use of magnetron sputtering devices to investigate He irradiation of W for fusion applications. The devices themselves allow sputtering of a known metal target due to confinement of plasma in front of the target, with energetic plasma ions bombarding the target surface and producing sputtered atoms which are deposited on a substrate. In this work this effect is used for insights in to deposition of metal atoms on to a W surface which will be transitioning to fuzz, and what the overall effect on the fuzz structure is in these deposition environments. Previous studies have focused on low fluence ranges in magnetrons (~10^{24} m^{-2}) but here we look at higher fluence (≥10^{24} m^{-2}), deposition regimes. The ion energy is varied from the non-sputtering regime (≤100eV) to the sputtering regime of He on W (≥100eV). The surface structures produced from these two investigations will be analysed using SEM and FIB-SEM for thickness data, and EDX analysis for the chemical composition of the structures.

Keywords
Tungsten
Helium
Nanostructure
Fuzz