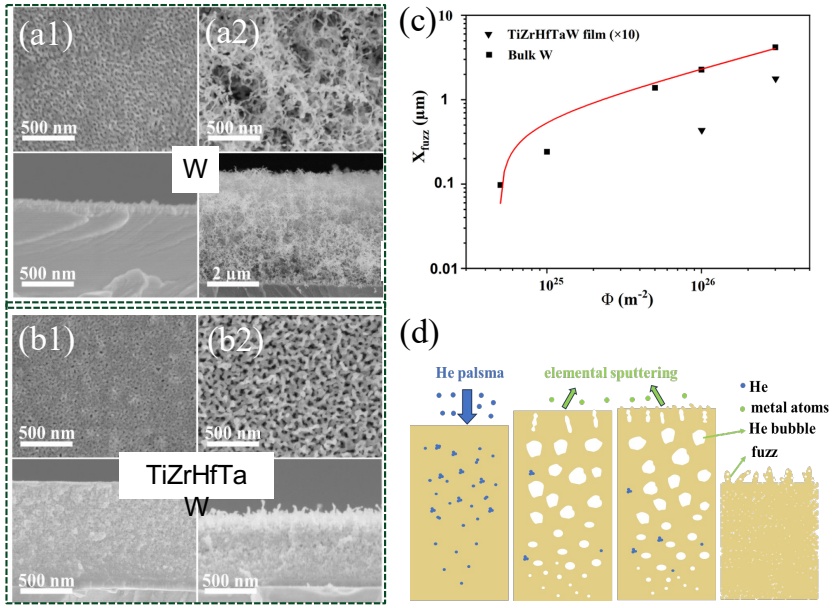
# A New Type of Plasma Irradiation-Resistant Amorphous TiZrHfTaW Refractory Multi-component Alloy




(a) Surface and cross-sectional SEM of the W (a) and amorphous TiZrHfTaW film (b) irradiated by He plasma to fluences of 5 × $10^{24}$ (a1,b1) and 3 × $10^{26}$ (a2, b2) ions/$m^2$. (c) Fuzz thickness of the amorphous TiZrHfTaW film and W. (d) Mechanism diagram of TiZrHfTaW film morphology changes with increasing irradiation fluence.

## Scientific Achievement

Discovery of new plasma facing materials, amorphous TiZrHfTaW film, with enhanced radiation resistance with a new mechanism.

## Significance and Impact

Finding high performance plasma-facing materials for realization of commercial application of fusion reactors is a challenging task. With this new material, He migrates and merges to form large number of relatively small helium bubbles, leading to the formation of nanoporous structures, which blocks the diffusion of He.

### Research Details

- The amorphous TiZrHfTaW films were deposited on W discs by ultrahigh vacuum DC magnetron sputtering at room temperature .
- The samples were exposed to the high-flux He plasma (50 eV) at ion flux of 1 × 1022 ions/m2s and temperature of around 1275 K.
- The threshold fluence for forming fuzz structure in TiZrHfTaW film is increased greatly to 20 times higher and the length of fuzz irradiated to the fluence of 3 × 1026 ions/m2 is 28 times shorter than those of bulk W.

Work was performed, in part, at the Center for Integrated Nanotechnologies.

Ge, W.; Cai, G.; Qu, C.; Wei, G.; Ni, W.; Zhong, F.; Guo, E.; Fu, B.; Hong, M.; Wang, Y.; Ren, F. A New Type of Plasma Irradiation-Resistant Amorphous TiZrHfTaW Refractory Multi-Component Alloy. Acta Materialia 2025, 288, 120822.