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Behaviors of Hydrogen, Helium and their Synergy in Tungsten
GUANG-HONG LU, School of Physics & Nuclear Energy Engineering, Beihang University, Beijing 100191, China — Tungsten (W) is one of the most promising plasma facing material (PFM) candidates for fusion energy systems. However, effects of hydrogen (H) isotopes and helium (He) particularly their retention and blistering in W remain to be key issues that need to be addressed. In this talk, we will discuss the effects of H and He in W in terms of the physical mechanism revealed by simulations in combination with related experiments. Via modelling and simulation in different scales, the nucleation and growth mechanism of H bubbles in W have been investigated. First-principles calculations show that a vacancy induces collective H binding on its internal surface. Further calculations suggest a cascading effect of H bubble growth in W. Based on such vacancy trapping mechanism, He as well as other inert gas elements such as neon and argon can suppress the H bubble nucleation and blistering, which is confirmed by the experimental observation. Difference between H and He behaviors and their synergy in W due to their different electronic structure will be emphasized, from which we can further consider the actual complicated H/He interaction with W and their effects on (mechanical) properties of W in future fusion reactors.

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