Bursting of nanobubbles in tungsten induced by impact of helium plasma ions of elevated energy

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Under specific conditions, irradiation of tungsten (W) by energetic helium (He) ions can induce the formation of fuzz-like nanostructures. Development of nanostructured surface morphology facilitates the conditions for unipolar arc ignition [1, 2]. Interestingly, electric breakdowns were experimentally observed to occur on W fuzz even without a trigger [1], when the near-wall potential was increased up to ∼500 V. The latter inspires to study the effects related to W fuzz under conditions corresponding to the regime of spontaneous breakdown initiation. In this work, the main attention is paid to early stages of W fuzz growth when conglomerates of He-nanobubbles form in the subsurface layer. By means of molecular dynamics simulations, the interaction of energetic He-atoms ($E \geq 100$ eV) with a He-bubble, pre-existing in the W surface layer, is analysed. It is shown that implantation of a He-atom can trigger the bursting of near-surface bubbles when the initial energy of impinging He-atom is of the same order as the He-bubble energy [3]. The conditions of He-bubble bursting are further clarified depending on the size, filling ratio, nucleation depth of a He-bubble and the initial energy of the impinging He-atom. Simulations were carried out using the resources of the NRNU MEPhI high-performance computing center. The research was financially supported by the Russian Science Foundation (project No. 22-12-00274).

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