Response of nanostructured tungsten surfaces to irradiation with energetic helium ions from radio-frequency plasma

Kukushkina M S[1,2], Kharkov M M[2], Kolodko D V[1,2,3], Rykunov G I[1,2], Kaziev A V[1,2,@] and Tsventoukh M M[1]

[1] Lebedev Physical Institute of the Russian Academy of Sciences, Leninsky Avenue 53, Moscow 119991, Russia
[2] National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Kashirskoe Shosse 31, Moscow 115409, Russia
[3] Fryazino Branch of the Kotelnikov Institute of Radioengineering and Electronics of the Russian Academy of Sciences, Vvedenskogo Square 1, Fryazino, Moscow Region 141120, Russia

[@] kaziev@plasma.mephi.ru

Tungsten fuzz layers formed on the plasma-facing material surfaces of thermonuclear facilities due to helium ion irradiation are known to facilitate the initiation of electrical discharges on the first wall. Previous studies have indicated increased arcing probability with increasing incident helium ion energy from 100 to 800 eV. Here, we experimentally consider the growth of nanostructures on tungsten surfaces in rf plasma and the effects caused by elevating the energy of incident helium ions up to 20 keV. Experiments were carried out in Bella rf facility. A planar coil mounted inside a vacuum chamber was used to generate inductively coupled plasma. The operating frequency of the rf power source was 13.56 MHz. Maximum rf power was 3 kW. At first, the nanostructured W samples were prepared by irradiation with low-energy helium ions. Then, microsecond-scale high-voltage pulses (up to 20 kV) were applied to the samples. The current and voltage in the sample biasing circuit were monitored. The maximum arc discharge current was 15 A (limited by the power supply parameters). After the experiments, the samples were studied in a scanning electron microscope.
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