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Arcing on fuzzy nanostructures

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Helium ion bombardment, which can occur on plasma facing walls in nuclear fusion devices, forms metallic fuzzy nanostructures on the surface [1]. Interestingly the nanostructure growth accompanied by helium bubble formation occurs on various metals, such as tungsten, molybdenum, tantalum, iron, nickel, and rhenium. In this study, we conducted (unipolar) arc experiments using the nanostructured materials in plasma environment, which simulates the environment in nuclear fusion devices. By using laser pulses and/or biasing the sample, arcing were ignited on the material. Fractal features and retrograde motion of arc spot were observed using the fast framing camera and on trails recorded on the surface. The retrograde motion significantly altered by changing the magnetic field strength and the thickness of the nanostructured layer. Especially when the nanostructured layer is thick, say thicker than 1 micron meter, arc spots were entangled together and formed grouping. Formation of grouping and spot splits were frequently identified from the arc trail recorded on the nanostructures. Also, from the field emission measurement from the material, it is shown that field emission significantly enhanced by the nanostructures.

[1] S Kajita et al, Nucl. Fusion 49 (2009) 095005.

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