Bubble formation on plasma irradiated tungsten surface

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Sheet plasma sources produce reaction regions with high density gradient ideal for thin films and coatings applications. This plasma configuration is realized by combining linear magnetic field to a dual dipole magnetic field.

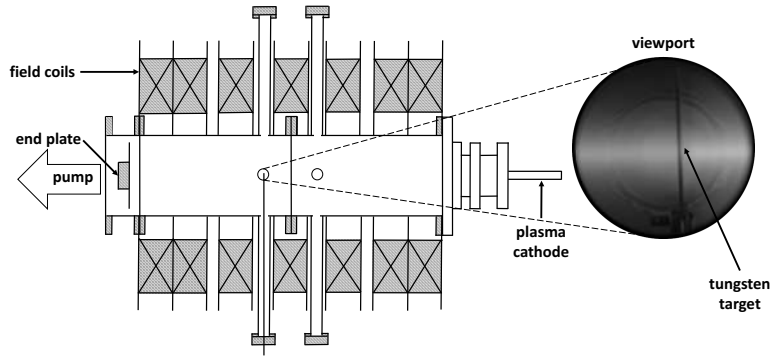

Figure 1: Device setup showing the W sample immersed in the sheet plasma as viewed from the chamber viewport.

Less than a cm thick He plasma was used to irradiate W surface at varying exposure times and incident ion energies to study the temporal surface evolution and effects of plasma dense regions on nanostructure formations. Surface structures were observed using a scanning electron microscope. Surface temperature during initial stages of irradiation was measured using an IR thermometer. Formation of blisters, bubbles and initial fuzz growth on the irradiated surfaces was observed at temperatures 883-919 K.

From electroctatic prob measurements, the plasma potential is determined to be around 1 eV. The incident ion energy of He plasma was calculated from the measured plasma potential and the applied substrate bias[1-2]. The substrate was biased negative to repel incident electrons and accelerate ions incident on the substrate. Applied bias voltage is at least one order of magnitude greater, thus, the ion energy is highly dependent on the applied substrate bias. Blister formations and evolution at different sizes ranging from a μm across and larger are observed in clusters were observed at ~10eV. Smaller and more robust bubbles occur at higher energies.

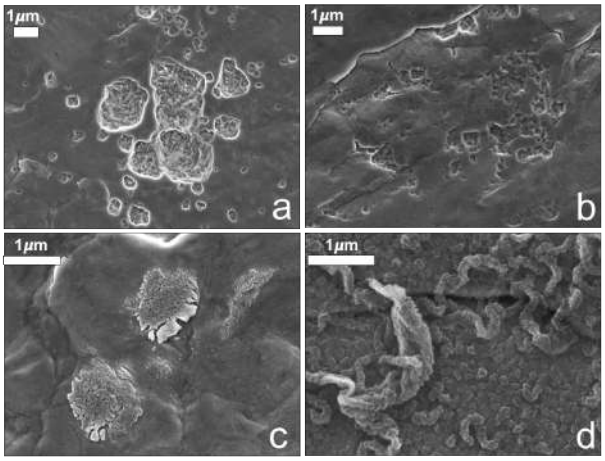

Figure 2: SEM micrograph of W surface exhibiting different surface nanostructures such as (a) blusters due to He bubbles, (b) surface pitting and exposed He bubbles, (c) burst blisters, and (d) W fuzz.

[1] S. Kajita *et al*. Phys. Scr. **89** (2014) 025602.

[2] T.J. Petty *et al*. Nucl. Fusion **55** (2015) 093033.