Low-density metal nanostructure interacting with plasma and energy fluxes

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Tungsten fuzz nanostructured layers being formed under helium-plasma ions flux. The energy of falling ions should be typically below 100 eV—that is below He–W physical sputtering. At the elevated energies 400–500 eV spontaneous (triggerless) breakdowns occur—that means micron-size metal plasma splashes formation from the nanostructure layer.

From the properties of such a plasma one may derive the properties of a nanostructure, id est one may estimate average cohesive energy for W fuzz to be $E_{\rm coh} \sim 10\ n/n_0$ eV, where n/n_0 is the nanostructure-to-tungsten density [Tsventoukh 2023 Phys. Plasmas 30 092511].

Low average concentration of matter of fuzz nanostructure could be favorable for the fast (fs) laser pulse absorption. The critical density of the plasma is about $n_{\rm cr} \approx 1.1 \times 10^{13}\ {\rm cm}^{-1}/\lambda^2$ that corresponds with the average density $3 \times 10^{21}\ {\rm cm}^{-3}$ to the laser wavelength of about 600 nm.

Fast bursting of near-surface nanobubbles in W fuzz under impact of He of elevated energy has been found [Kulagin, Tsventoukh 2024 JETP, in press]. Tungsten nanowire conductivity reduction due to electron scattering by ensemble of He-nanobubbles has been estimated.

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