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Proposed Heuristic Model for Fuzz Growth on Metal Surfaces[1]

ROMAN OCHOUKOV, DENNIS WHYTE, MIT — The growth of nano-scale rods, or fuzz, is observed experimentally on tungsten and molybdenum surfaces exposed to an incident He flux with ion energies >10 eV. It is experimentally determined that the growth of fuzz follows a diffusion-like equation as a function of the He exposure time t: $x \sim (2Dt)^{1/2}$, where x is the fuzz thickness and D is the effective diffusion coefficient. This growth is consistent with the incident He flux Γ_o being reduced at a rate of $d\Gamma(x)/dx = -\alpha\Gamma(x)^{3/2}$ as the He ions traverse the fuzz. α is an integration constant. Based on the above assumption, we derived a relation between x, Γ_o, and t: $x + 2\alpha^{-1}\Gamma_o^{-1/2} = (2Dt)^{1/2}$. The notable features of this equation, for a fixed exposure time, are: 1) the saturation of the fuzz thickness as Γ_o approaches ∞ and 2) the minimum threshold value of the incident He flux Γ_o required to initiate fuzz growth. Both of these features are experimentally observed. Another notable feature is that it requires a minimum He fluence $\Gamma_o t_{min}$ at the metal surface to initiate fuzz growth.

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