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Coupling of morphology to surface transport in ion-beam irradiated surfaces: Oblique incidence

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Abstract-

We propose and study a continuum model for the dynamics of amorphizable surfaces undergoing ion-beam sputtering IBS at intermediate energies and oblique incidence. After considering the current limitations of more standard descriptions in which a single evolution equation is posed for the surface height, we overcome some of them by explicitly formulating the dynamics of the species that transport along the surface and by coupling it to that of the surface height proper. In this, we follow recent proposals inspired by “hydrodynamic” descriptions of pattern formation in aeolian sand dunes and ion-sputtered systems. From this enlarged model and by exploiting the time-scale separation among various dynamical processes in the system, we derive a single height equation in which coefficients can be related to experimental parameters. This equation generalizes those obtained by previous continuum models and is able to account for many experimental features of pattern formation by IBS at oblique incidence, such as the evolution of the irradiation-induced thin amorphous layer, transverse ripple motion with nonuniform velocity, ripple coarsening, onset of kinetic roughening, and others. Additionally, the dynamics of the full two-field model is compared with that of the effective interface equation.

Index Terms-

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