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Coupling of morphology to surface transport in ion-beam-irradiated surfaces: normal incidence and rotating targets

J. Munoz-Garcia, R. Cuerno, M. Castro

Abstract— Continuum models have proved their applicability to describe nanopatterns produced by ion-beam sputtering of amorphous or amorphizable targets at low and medium energies. Here
we pursue the recently introduced 'hydrodynamic approach' in the cases of bombardment at normal incidence, or of oblique incidence onto rotating targets, known to lead to self-organized
arrangements of nanodots. Our approach stresses the dynamical roles of material (defect) transport at the target surface and of local redeposition. By applying results previously derived
for arbitrary angles of incidence, we derive effective evolution equations for these geometries of incidence, which are then numerically studied. Moreover, we show that within our model these
equations are identical (albeit with different coefficients) in both cases, provided surface tension is isotropic in the target. We thus account for the common dynamics for both types of incidence conditions, namely formation of dots with short-range order and long-wavelength disorder, and an intermediate coarsening of dot features that improves the local order of the patterns. We provide for the first time approximate analytical predictions for the dependence of stationary dot features (amplitude and wavelength) on phenomenological parameters, that improve upon previous linear estimates. Finally, our theoretical results are discussed in terms of experimental data.
(Some figures in this article are in colour only in the electronic version)

Index Terms—

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