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Independence of interrupted coarsening on initial system order: ion-beam nanopatterning of amorphous versus crystalline silicon targets

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Abstract-

Interrupted coarsening (IC) has recently been identified as an important feature for the dynamics of the typical length-scale in pattern-forming systems on surfaces. In practice, it can be beneficial to improve pattern ordering since it combines a certain degree of defect suppression with a limited increase in the typical pattern wavelength. However, little is known about its robustness with respect to changes in the preparation of the initial system for cases with potential applications. Working in the context of nano-scale pattern formation by ion-beam sputtering (IBS), we prove that IC properties do not depend on sample preparation. Specifically, interface dynamics under IBS is quantitatively compared on virgin amorphous and crystalline silicon surfaces, using 1 keV ArC ions at normal incidence where nanodot pattern formation is triggered by concurrent co-deposition of Fe atoms during processing. Atomic force microscopy shows that dot patterns with similar spatial order and dynamics are obtained in both cases, underscoring the key dynamical role of the amorphous surface layer produced by irradiation. Both systems have been quantitatively described by an effective interface equation. We employ a new procedure based on the linear growth of the initial surface correlations to accurately estimate the equation coefficients. Such a method improves the predictive power of the interface equation with respect to previous studies and leads to a better description of the experimental pattern and its dynamical features.

Index Terms-

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