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Symmetry of surface nanopatterns induced by ion-beam sputtering: role of anisotropic surface diffusion

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Abstract-

Ion-beam sputtering (IBS) is a cost-effective technique able to produce ordered nanopatterns on the surfaces of different materials. To date, most theoretical studies of this process have focused on systems which become amorphous under irradiation, e.g., semiconductors at room temperature. Thus, in spite of the large amount of experimental work on metals, or more recently on semiconductors at high temperatures, such experimental contexts have received relatively little theoretical attention. These systems are characterized by transport mechanisms, e.g., surface diffusion, which are anisotropic as a reflection of the crystalline structure not being overruled by the irradiation. Here, we generalize a previous continuum theory of IBS at normal incidence, in order to account for anisotropic surface diffusion. We explore systematically our generalized model in order to understand the role of anisotropy in the space-ordering properties of the resulting patterns. In particular, we derive a height equation which predicts morphological transitions among hexagonal and rectangular patterns as a function of system parameters and employ an angular correlation function to assess these pattern symmetries. By suitably choosing experimental conditions, it is found that one might be able to experimentally control the type of order displayed by the patterns produced.

Index Terms-

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