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Nanoscale pattern formation at surfaces under ion-beam sputtering: a perspective from continuum models

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Abstract— Although reports on surface nanostructuring of solid targets by low to medium energy ion irradiation date back to the 1960s, only with the advent of high resolution tools for surface/interface characterization has the high potential of this procedure been recognized as a method for efficient production of surface patterns. Such morphologies are made up of periodic arrangements of nanometric sized features, like ripples and dots, with interest for technological applications due to their electronic, magnetic, and optical properties. Thus, roughly for the last ten years large efforts have been directed towards harnessing this nanofabrication technique. However, and particularly in view of recent experimental developments, we can say that the basic mechanisms controlling these pattern formation processes remain poorly understood. The lack of nanostructuring at low angles of incidence on some pure monoelemental targets, the role of impurities in the surface dynamics and other recent observations are challenging the classic view on the phenomenon as the mere interplay between the curvature dependence of the sputtering yield and surface diffusion. We review the main attempts at a theoretical (continuum) description of these systems, with emphasis on recent developments. Strong hints already exist that the nature of the morphological instability has to be rethought as originating in the material flow that is induced by the ion beam.

Index Terms— Nanoscale pattern formation; Ion-beam sputtering; Surfaces; Morphological instabilities; Continuum models

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