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Stress vs sputtering effects in the propagation of surface ripples produced by ion-beam sputtering

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Abstract— Under low energy ion irradiation, periodic features (ripples) can develop on the surfaces of semiconductor materials, with typical sizes in the nanometric range. Recently, a theory of pattern formation has been able to account for the variability with the ion/target combination of the critical angle value separating conditions on ion incidence that induce the presence or the absence of ripples. Such a theory is based in the accumulation of stress in the damaged irradiated layer and its relaxation via surface-confined viscous flow. Here we explore the role of stress, and its competition with purely erosive mechanisms, to determine the sign of the velocity with which the ripple pattern moves across the target plane. Based on this theory, we discuss different situations and make specific testable predictions for the change of sign in that velocity.

Index Terms— Surface nanostructuring; Ion-beam sputtering; Continuum models; Stress-induced viscous flow; Ripple velocity

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