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Nanoscale Terraced Topographies Produced by Ion Bombardment of Solid Surfaces[1]

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Bombarding a solid surface with an obliquely-incident, broad ion beam can lead to the emergence of surface ripples with wavelengths as short as 10 nanometers. The anisotropic Kuramoto-Sivashinsky (AKS) equation has been used to model the formation of these ripples for more than two decades. However, when the angle of incidence is large, intriguing phenomena are observed that are not reproduced by the AKS equation. We have introduced an equation of motion for the surface of an ion-bombarded material that differs from the AKS equation by the inclusion of a cubic nonlinearity. This additional nonlinear term results from an improved approximation to the sputter yield. We have shown that this term can have a crucial influence on the dynamics — it can lead to the formation of a terraced topography that coarsens in time, in accord with experimental observations for high incidence angles. Our simulations also establish that regular terraced surfaces produced by bombarding a surface with a sinusoidal pre-pattern could serve as highly efficient blazed diffraction gratings.

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