

# Stress-induced solid flow drives surface nanopatterning of silicon by ion-beam irradiation

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**Abstract—** Ion-beam sputtering (IBS) is known to produce surface nanopatterns over macroscopic areas on a wide range of materials. However, in spite of the technological potential of this route to nanostructuring, the physical process by which these surfaces self-organize remains poorly understood. We have performed detailed experiments of IBS on Si substrates that validate dynamical and morphological predictions from a hydrodynamic description of the phenomenon. We introduce a systematic approach to perform the experiments under conditions that guarantee the applicability of a linear description, helping to clarify the experimental framework in which theories should be tested. Among our results, the pattern wavelength is experimentally seen to depend almost linearly on ion energy, in agreement with existing results for other targets that are amorphous or become so under irradiation. Our work substantiates flow of a nanoscopically thin and highly viscous surface layer, driven by the stress created by the ion beam, as an accurate description of this class of systems.

## Index Terms—

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## Citation:

Castro, M.; Gago, R.; Vázquez, L.; Munoz-Garcia, J.; Cuerno, R.; "Stress-induced solid flow drives surface nanopatterning of silicon by ion-beam irradiation", *Physical Review B*, vol.86, no., pp.214107-1-214107-7. December, 2012.