University of Maryland NSF-MRSEC Highlight:

Directed Self Organization of Step Bunches on Patterned Vicinal Si(111)

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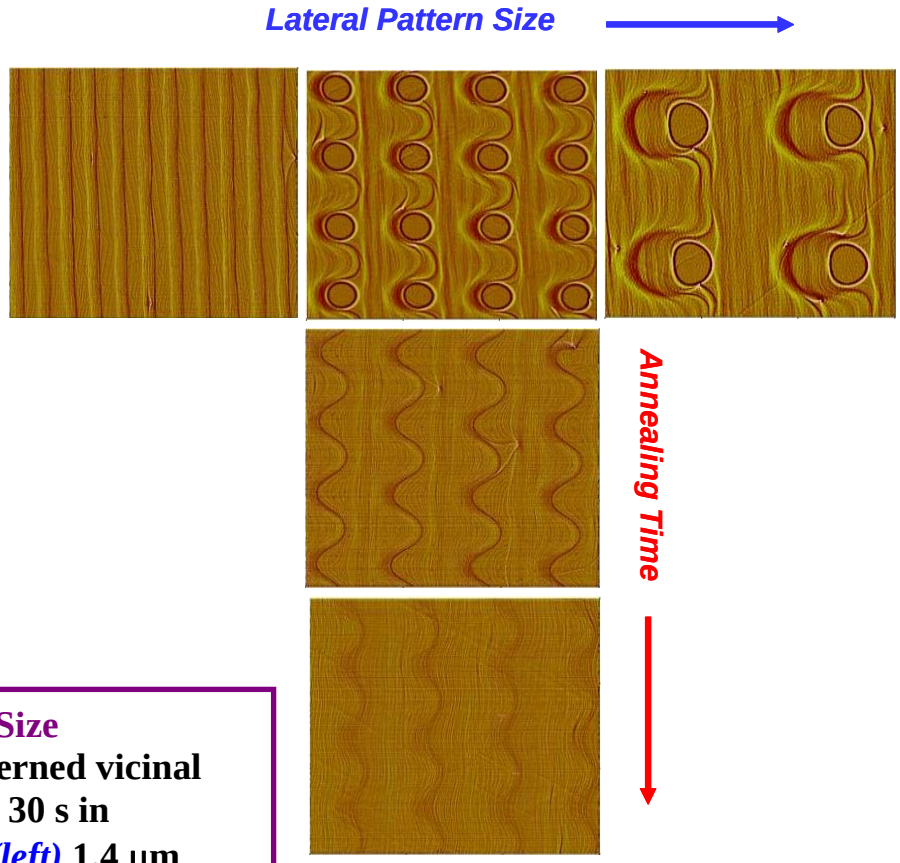
High-temperature annealing of lithographically patterned vicinal Si(111) surfaces shows an intriguing *length-scale dependence of self-organization of step-bunches* – resulting from the motion and interference of misorientation-derived straight steps and the circular steps which bound cylindrical pits. Annealing of patterns with *small pit diameters* produces a *rapid relaxation to straight step-bunches,* while *larger structures maintain significant in-plane corrugations* for as long as the out-of-plane corrugations persist. This indicates the existence of a characteristic length scale, set by the competition between the Gibbs-Thomson effect and sublimation. Significantly, the eventual relaxation is to nearly uniform step trains indicating that the late stage evolution is dominated by repulsive step-step interactions.



Variation of Self-Organization with Pattern Size

(Top row) Topography resulting from annealing pit-patterned vicinal Si(111) surfaces vs. pattern length at T=1273˚C for 30 s in ultrahigh vacuum. Initial pattern dimensions are *(left)* 1.4 μm diameter x 2.8 μm pitch, *(center)* 4 μm diameter x 8 μm pitch and *(right)* 8 μm diameter x 16.0 μm pitch.

(Middle column) Effect of increasing annealing time for initial pattern dimensions of 4.0 um diameter, 8.0 um pitch. *(top)* 30 s, *(center)* 65 s, *(bottom)* 120 s. Initial pit depths are approximately 35 nm.