Step Motion Near Dislocations on Si Surfaces

J.B. Hannon[1], V.B. Shenoy[2], and K.W. Schwarz[1]

[1]IBM Research Division, T.J. Watson Research Center, Yorktown Heights, NY 10598
[2]Division of Engineering, Brown University, Providence, RI 02912

We have used low-energy electron microscopy to measure step motion on Si(111) and Si(001) near dislocations during growth and sublimation. Steps on Si(111) exhibit the classic rotating spiral motion predicted by Burton, Cabrera and Frank [1]. Steps on Si(001), however, move in a strikingly different manner that appears to violate the Gibbs-Thomson relation. The step profiles exhibit both positive and negative curvature and move with an almost discontinuous, ratchet-like motion. The anomalous behavior can be understood in detail by considering how the local step velocity is affected by the non-uniform strain field arising from the dislocation. The strain from the dislocation locally favors one of the two surface domains, leading to a thermodynamic force on the steps. By computing the surface strain field for various dislocation geometries, and simulating the step motion during sublimation, we are able to determine the specific slip system observed in experiment [2].

[1] W. K. Burton, N. Cabrera, and F. C. Frank, *Proc. Roy. Soc.*, A243 (1950) 229.

[2] J. B. Hannon, V. B. Shenoy, and K. W. Schwarz, to appear in *Science*.