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Spatial First-passage Statistics of Al/Si(111)-($\sqrt{3} \times \sqrt{3}$) Step Fluctuations: Implications for Nanoscale Structures[1] BRAD CONRAD, WILLIAM CULLEN, University of Maryland, DANIEL DOUGHERTY, NIST, IGOR LYUBINETSKY, PNNL, ELLEN WILLIAMS, University of Maryland — The step-edges on a multi-component surface of Al/Si(111)-($\sqrt{3} \times \sqrt{3}$), observed via scanning tunneling microscopy, fluctuate in thermal equilibrium over a temperature range of 720K-1070K. For step lengths L = 65-160 nm, the measured first-passage spatial persistence and survival probabilities are found to be temperature independent and thus universally applicable. The power-law functional form for spatial persistence probabilities is confirmed, and the symmetric spatial persistence exponent is measured to be $\theta = 0.53 \pm 0.05$, in agreement with the theoretical prediction $\theta = \frac{1}{2}$. The survival probability is found to scale with y/L, where y is the distance along the step edge. The functional form of the survival probabilities agrees quantitatively with the theoretical prediction, which decays exponentially as exp(-y/y_s) for small y/L. The experiment finds the decay constant to be y_s/L= 0.076 ± 0.033 for y/L ≤ 0.2. The physical implications of these results for the predictability of nanoscale displacements and thus on device design and manufacturing will be discussed.

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