Spatial First-passage Statistics of Al/Si(111)\text{-}(\sqrt{3} \times \sqrt{3}) \text{ Step Fluctuations: Implications for Nanoscale Structures}^{\text{1}} \text{ 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)\text{-}(\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 \text{ 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, \text{ in agreement with the theoretical prediction } \theta = \frac{1}{2}. \text{ The survival probability is found to scale with } y/L, \text{ where } y \text{ is the distance along the step edge. The functional form of the survival probabilities agrees quantitatively with the theoretical prediction, which decays exponentially as } \text{exp}(-y/y_s) \text{ for small } y/L. \text{ The experiment finds the decay constant to be } y_s/L = 0.076 \pm 0.033 \text{ for } y/L \leq 0.2. \text{ 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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