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Direct Measurement of Curvature Dependent Ion Etching of GaN

BENTAU CUI, University of Minnesota, PHILIP COHEN, University of Minnesota, AMIR DABIRAN, SVT Associates — The formation of ion induced nanoscale patterns, such as ripple or dimples, can be described using a continuum equation including a surface roughening term (curvature-dependent sputtering or asymmetric attachment of mobile adatoms/defects), a surface smoothing term (thermal or/and ion induced diffusion), and noise term. By measuring the roughening coefficient of the continuum equation, we have found the Ehrlich-Schwoebel length is 5.2 nm and the step-edge barrier is 1.2 eV at 733K. A Kaufman ion source was used to supply sub-keV ions from glancing incidence. The surface morphology was examined using RHEED in situ and AFM afterwards. The samples were rotated at 1.2 rpm to preclude ripple generation. Dimple structures with diameters ranging from 30 nm to 800 nm, have been produced using both argon ions and nitrogen ions with energies ranging from 60 - 1200 eV at an ion flux of 3.6 ions $s^{-1}nm^{-2}$. Using both RHEED and AFM we measure a minimum in the local roughness near 320 C. From the evolution of the dimple dimensions we obtain the first direct measurement of the curvature driven roughening, and the roughening coefficient is measured to be 43.2 nm^2/s. The activation energy for surface relaxation has been measured to be 0.11 eV.

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Philip Cohen
University of Minnesota

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