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The Dynamic World of Surface Nanostructures

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The stability of nanostructures after their creation is a critical issue for nanotechnology. To address this issue, one must study the fundamental mechanisms of atomic scale mass transport on surfaces. We have approached this problem through detailed observation of the behavior of surface structures including 2-dimensional islands and step edges as well as pyramidal mounds on Cu(100) and (111) surfaces at 297 K after their creation by molecular beam deposition of Cu atoms. Movies produced from sequential STM images obtained over periods up to 24 hours reveal striking differences in the decay processes on the (100) vs. the (111) surfaces. The primary difference is associated with the rapid decay or avalanche process of a 2-dimensional island upon migration to a step edge. This process is highly orientation dependent on the (100) surface and orientation insensitive on the (111) surface. The behavior observed can be generalized to other systems and depends only on the selectivity of the edge decay process.

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