

Silicon Surface Smoothing by Argon Cluster Impact

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A cluster is an assemblage of individual atoms with a few to several thousand constituents. Because there are many atoms per cluster, an ionized cluster beam can have low energy per atom and high atom flux at the same time. This feature can be advantageous for achieving shallow implantation, surface smoothing, low damage surface cleaning, and thin film formation. In this study, the molecular dynamics (MD) simulation method was used to study Si (001) surface smoothing and substrate damage induced by the impact of Ar clusters with low energy/atom. MD is the appropriate method for studying the mechanism of cluster-solid interaction because the positions and velocity of projectiles and target atoms can be followed. A pyramidal protrusion on an otherwise flat Si surface was used as a model roughness. The number of atoms per cluster and energy of Ar clusters were ranged 16 ~ 128 and 1 ~ 15 eV, respectively. The angle of Ar clusters impinging on the substrate was also varied from 0° to 45°. It was found that cluster impact showed characteristic behaviors such as multiple collisions and lateral displacement. Preliminary results revealed that the surface roughness and substrate damage were minimized at the specific energy per constituent atoms at a given cluster size and incidence angle.