

An Overview on Ion Beam interaction with Matter: Discovery, Understanding, Applications, and Current Status

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2011 marks the centennial of Rutherford Backscattering experiment (1911), which has made significant impact toward the development of modern physics, such as laying foundation to the shell model of atom, development of accelerators, development of atomic and nuclear physics etc. Recently, American Physical Society has decided to mark the Rutherford's experiment as the beginning of a century of elementary particle physics. In my talk, I will cover a much lower energy region (keV-10 MeV), where small accelerator, such as the one at UH can contribute to ongoing research in Physics. I will cover two subjects related to student's dissertations topics. One on ion beam channeling in single crystals, and the second one on cluster ion beam modification of surfaces.

1.) When an energetic ion projectile enters a single crystal along a major crystalline axial or planar direction, the collective Coulomb potential from a crystal steers the ion away from the lattice atoms. Ion channeling in a crystalline solid can be observed as a great reduction of close encounter processes, such as elastic Rutherford scattering, ion induced X-ray emission, and nuclear reactions, due to the steering of ions away from the nuclei array. The phenomenon is well adopted as a powerful real-space analytical tool, which can be used to study lattice dynamics, depth resolved crystalline defect analysis, strain analysis, and ion-beam crystallography.

2.) A cluster ion is an ionized particle made of a few hundred to a few thousand atoms. When bombarding a surface with an energetic beam of cluster ions, the simultaneous arrival of many atoms at the same location of the target surface produces a synergistic effect, which cannot be extrapolated from multiple single ion bombardment. A cluster ion beam could smooth a rough surface if it is aimed normal to the surface. It can form nano-sized ripples on a surface, if aimed off normal to the surface. I will describe our observation, give explanation and related to potential applications.