MATERIALS SCIENCE AND ENGINEERING SEMINAR

Cluster Ion Beam Irradiation: Interaction mechanisms and applications

by

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ABSTRACT

Irradiation with cluster of ions (cluster ion beam irradiation) instead of monomeric ions (monomer ion beam irradiation) leads to vast differences in the beam-surface interaction. Multiple and overlapping collision cascades, and the low energy per atom (few eVs) cause lateral sputtering of atoms in the case of cluster ion beam irradiation, which was shown to lead to large enhancement in surface smoothing (few angstrom roughness with no scratches or asperities), sputtering yields, low temperature thin film formation, and shallow implantation. On the other hand, cluster ion beam irradiation throughput needs to be enhanced (mA cluster ion beam currents are required) and some work is still missing to judge about the replacement of monomer ion beam application in industry with cluster ion beam. Moreover, cluster ion beam irradiation leads to very high local temperatures (104-105 K) and pressures (1Mbar) that may be a cause of high defects density underneath the surface, which can lead to hardening of the material irradiated and to degradation in some of its mechanical and electrical properties. While in-situ Transmission Electron Microscopy (TEM) can give us some information about defects generation by cluster ion beam, cross section TEM and nanoindentation on cross sections of irradiated samples can help in obtaining the maximum depth of damage introduced by cluster ion beam irradiation. Resistance measurements on irradiated and non irradiated materials with cluster ion beam are also suggested to get information about the defects density and to test the electronic properties of the materials irradiated.

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