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Title: Monte Carlo Simulation of Secondary Electron Emission from Dielectric Targets

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In modern physics we are interested in systems with many degrees of freedom. The Monte Carlo (MC) method gives us a very accurate way to calculate definite integrals of high dimension: it evaluates the integrand at a random sampling of abscissa. MC is also used for evaluating the many physical quantities necessary to the study of the interactions of particle-beams with solid targets. Letting the particles carry out an artificial random walk and taking into account the effect of the single collisions, it is possible to accurately evaluate the diffusion process. The problem of the determination of secondary electron emission from solids irradiated by a particle beam is of crucial importance, especially in connection with the analytical techniques that utilize secondary electrons to investigate chemical and compositional properties of solids in the near surface layers. Secondary electrons are used for imaging in scanning electron microscopes, with applications ranging from secondary electron doping contrast in p-n junctions, line-width measurement in critical-dimension scanning electron microscopy, to the study of biological samples. When a stream of electrons impinges on a solid target, the incident particles (during their travel within the solid) lose energy and change direction at each collision with the atoms bound in the solid. Nuclear collisions deflect the electrons without relevant kinetic-energy transfer, owing to the large difference between the masses of the electron and the nucleus: the differential elastic scattering cross-section has to be used in order to describe these processes (Mott cross section). On the other hand, excitations and ejections of atomic electrons, and plasmon, phonon, and polaron excitations affect the energy dissipation but only slightly affect the direction of the electron in the solid. These can be described as inelastic processes, governed by the equations for the differential inelastic scattering cross-sections. In this work, the main mechanisms of scattering and energy loss of electrons scattered in dielectric materials are briefly treated. Then a description of the used MC scheme follows. The MC code takes into account all the single energy losses suffered by each electron in the secondary electron cascade, and is rather accurate for the calculation of the secondary electron yield and energy distribution as well. Selected applications of the code to the secondary electron emission from SiO2, Al2O3, and PMMA are presented to illustrate the applicability of the numerical code.