

Article

Spectra of Low Energy Electrons Emitted in the Interaction of Slow Ne⁺ Ions with Mg Surfaces

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Abstract: We measured spectra of low energy electrons emitted in the interaction of singly charged Ne⁺ ions with the Mg surface at incident ion energies ranging from 50 eV to 4 keV. The study examines issues related to the excitation of both the surface and the bulk plasmons of the target. We will also focus on the dynamics of the production of the singlet Ne2p⁴(¹D)3s² and triplet Ne2p⁴(³P)3s² autoionizing states of projectiles scattered in a vacuum. The threshold behavior of the autoionization lines show that double excitation occurs simultaneously in a single scattering. The predominant excitation of the triplet state indicates the importance of charge rearrangement and the electron correlation effects during the collisional excitation.

Keywords: surface scattering; autoionization and Auger processes; plasmons; electron emission

1. Introduction

Electron emission is a fundamental consequence of the interaction of charged particles with the surfaces of solids and is of crucial importance in many applications, such as electrical discharge, spectroscopic techniques for the characterization of materials, as well as microscopy. Advances in all these research areas call for an improved understanding of electronic excitation and energy deposition and conversion processes in solids [1–3]. Two quantities are measured in studies of electron emission as a function of several variables, such as impact energy, incidence and emission angles, surface conditions, etc. These are the energy distributions of emitted electrons and their integrals, the electron emission yield. Knowledge of the yield, i.e., the number of electrons emitted per incident projectile, is generally required for these applications, while studies of the energy distribution of emitted electrons give information on specific emission phenomena, which are individuated by their characteristic spectral signatures. In the case of atomic projectiles, since they carry both potential and kinetic energy, a traditional classification divides electron emission phenomena into two main categories, namely that of potential electron emission and that of kinetic electron emission [1,4–11]. For potential electron emission (PEE) [1,4–7], the potential energy stored in the excited or ionized states of the projectiles is converted into electron excitation and emission by charge transfer processes between the projectile and the surface. The energy conversion occurs through non-local resonant and/or Auger processes that occur outside the surface and involve the electronic structure of the solid surface. Resonant charge transfer does not give origin to electron emission directly but can be the precursor of an Auger deexcitation process. Moreover, resonant processes can determine the charge and excitation state of impinging particles, which in turn determines the excitation process during a subsequent binary atomic collision. For example, according to the taxonomy introduced by Hagstrum [4], an incoming ion can be neutralized via Auger neutralization (AN), which involves two electrons from the solid surface, or via an interatomic Auger deexcitation following the resonant capture of an electron from the solid



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Low Energy Electron Spectrometry

Fred Moavenzadeh, Robert W. Cahn



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