eJSSNT
e-Journal of Surface Science and Nanotechnology

The Surface Science Society of Japan with Japan Science and Technology Agency
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Aims and Scope

Our electronic journal eJSSNT aims quick and versatile-style publication of research papers on fundamental theory and experiments at frontiers of science and technology relating to surfaces, interfaces, thin films, fine particles, nanowires, nanotubes, and other nanometer-scale structures, and their interdisciplinary areas such as crystal growth, vacuum technology, microscopy, spectroscopy, and so on. It covers their physics, chemistry, biology, materials science, and their applications to advanced technology for computations, communications, memory, catalysis, sensors, bio- and medical purposes, energy and environmental problems, and so on.

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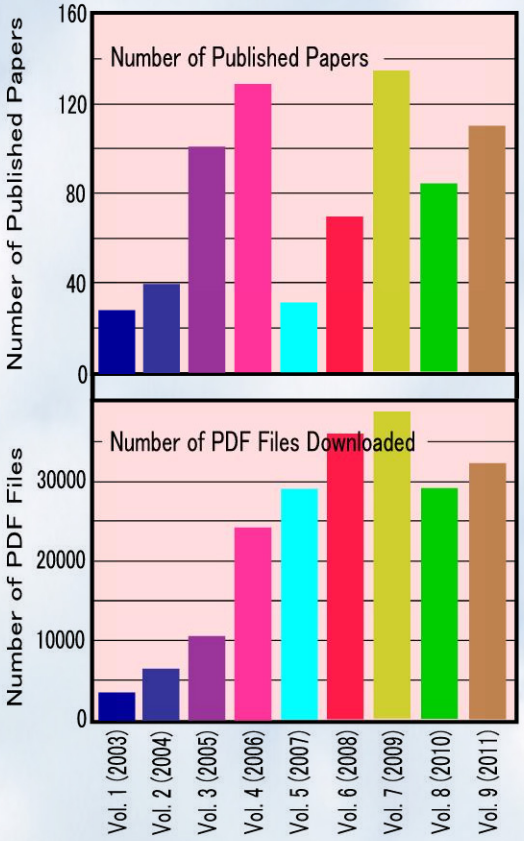

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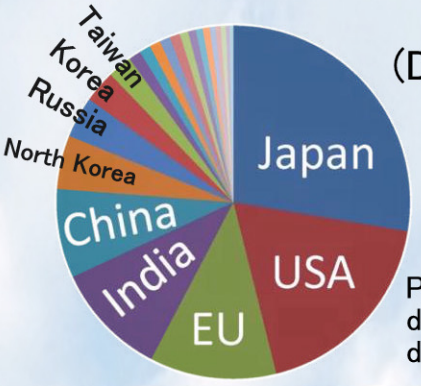

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e-Journal of Surface Science and Nanotechnology 16 April 2006
e-J. Surf. Sci. Nanotech. Vol. 4 (2006) 388-393 Conference -ALC05-

Interaction of slow multiply charged Ar ions with a LiF insulator surface*

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(Received 1 November 2005; Accepted 15 February 2006; Published 16 April 2006)

We have investigated electron emission for impact of slow multiply charged Ar ions on an atomically clean and flat insulating LiF(001) surface. Time-of-flight spectra and the number of emitted electrons have been determined in coincidence for grazing scattering of Ar^{q+} projectiles from LiF. By relating projectile energy loss to kinetic electron emission we were able to determine contributions from potential electron emission even in the presence of a considerable number of kinetically excited electrons. [DOI: 10.1380/ejssnt.2006.388]

Keywords: Ion-solid interactions; electron emission; alkali halides; ion scattering spectroscopy

I. INTRODUCTION

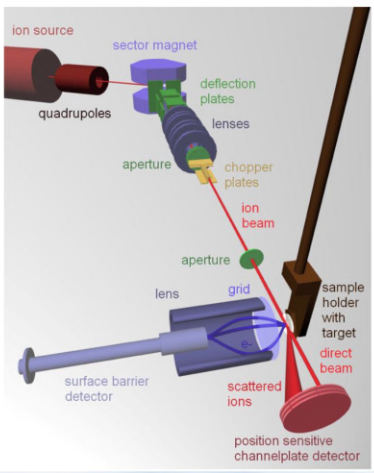
Impact of slow multiply charged ions (MCI velocity below 1 a.u. or 25 keV/amu) on atoms and molecules in the gas phase and on solid surfaces is relevant in various fields of research as, e.g., thermonuclear fusion, astrophysical and ionospheric plasmas, and surface chemistry and analytics [1–4]. More recent interest is due to the role which multicharged ions play as part of the solar wind in space environment [5]. "Space weathering" introduces chemical (composition) and physical (e.g. reflectivity) changes on the surface of asteroids and moons, while charging by solar wind-induced electron emission is the cause of many system anomalies and component failures in spacecrafts [6].

Nature and intensity of the resulting inelastic processes depend both on the kinetic and the potential (= internal) ion energy carried toward the surface [1, 7–11]. For slow MCI this potential energy (equal to the total ionisation energy which had to be spent for producing the MCI from its neutral atomic ground state) can become comparable to or even considerably exceed the ions kinetic energy, resulting in additional electron emission or sputtering (potential electron emission PE [9, 10, 12, 13], potential sputtering [14–18]), phenomena which are usually dominated by kinetic effects (kinetic electron emission KE [1, 7–9], kinetic sputtering [4, 19]). The relative importance of ion induced PE and KE from solid surfaces is not easy to determine. Measurements performed under grazing angles of incidence are of particular interest here, since the projectiles interaction with the surface proceeds along a well-defined trajectory (surface channeling [11]). More detailed information can be obtained if electron emission is observed in coincidence with the angular distribution of scattered projectiles. Recently, such measurements for multiply charged Ar ion impact on Au(111) have permitted a clear distinction of the contributions from PE and KE [20]. For slow, very highly charged ion impact PE usually becomes dominant and a separation procedure from KE is no longer needed.

In this work we describe experimental investigations of electron emission due to grazing MCI impact on insulating targets, where electronic properties (dielectric response, band gap, limited charge carrier mobility) may strongly affect the interaction scenario and add complexity to its theoretical description [21, 22]. For these investigations we have chosen the LiF(001) surface of a prototype wide-band gap insulator.

II. EXPERIMENTAL SETUP

A first attempt to separate PE and KE in coincidence measurements of ES and angular distributions of scat-



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