

## STATUS OF THE THEORY OF MeV-ION ELECTRONIC STOPPING INDUCED DESORPTION

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A review is given of the present status of the theoretical model calculations on electronic stopping of MeV-Ions, the subsequent selforganization of the electron shower into plasmons/excitons and its entropic coupling mechanism to atomic degrees of freedom leading to a mechanical shock wave. The coupling of it to the (nonlinear soliton-type) surface modes by the wellknown mode-scrambling mechanism [1] leads to the finally observable violent ejection of internally cold emission of pieces of matter (clusters, molecules). Thus the rich and wellstudied PDMS (Particle Desorption Mass Spectra) carry a wealth of information, which can now be connected to the assumptions on the primary electron stopping process.

Desorption by MeV-Ions emerges as a wonderful tool carrying rich detailed information to be used on the initial process of electronic excitation by the incoming ion.

More specifically the most relevant necessary input of the incoming ion is its change of charge in penetrating into the material. This can now be excellently studied by using the angular distribution, absolute yield and energy dependence of desorption spectra for ions which come in at a given angle and penetrate into matter of prepared and marked molecular monolayers. The technique used are the Langmuir-Blodgett molecular layer technique. [4,5].

The first step is to follow all the possible electron (of the incoming ion) to electron (of the solid) scattering processes, the formula of the individual processes being well known. The result is the abundance of primary secondary electrons as a function of their energy, location, time, angle.

The second step of the global complex process is dominated by electron-electron interactions between electrons of the secondary electron cloud. This leads and is understood as a process of selforganization of the electronic cloud. The coupling of the primary secondary electrons to atomic motions is in this stage relatively unimportant.

The third step is the subsequent coupling of the forming plasmon/exciton pulse to the passed by atomic bonds. They are momentarily loosened and gain energy according to the passing by time as can be easily seen from a time-dependent quantummechanical perturbation calculation. This in fact gives the typical "thermal" exponential factor of  $\exp(dE*dt/h)$ . Here the passing by time (divided by Plancks constant) comes exactly in place of the inverse of a "temperature", as one is used to in slow coupling processes. The passing time involved gives 10.000 K as a "temperature", exactly what is seen as the kinetic distribution of the desorbed fragments, which are internally cold. The latter is due to the fact that perturbation theory gives the amount of energy deposited proportional to the level density of the bond, thus loose v.d.Waals or other soft bonds get a large amount of excitation energy, while the inner covalent bonds e.g. of organic molecules are not excited.

Finally we present the results of a three-dimensional molecular dynamics calculation, giving the abundances of clusters as a function of their mass, energy, angle and the ion energy, charge, velocity, angle, -using the GSI-mainframe computer. The results can be qualitatively understood in terms of the shock-wave to soliton type coupling picture.

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