V-H Desorption Induced by Electronic Transitions at the Surface of Van der Waals Condensates

The electronic excitation on the surface of a van der Waals condensate may lead the desorption of neutral and charged molecules, either in the ground state or in excited ones. The phenomena discussed here are neither thermal desorption nor direct mechanical sputtering but processes through a transformation of an electronic excitation energy into a kinetic energy of a desorbing particle. Close investigation of this DIET (Desorption Induced by Electronic Transitions) phenomena will reveal the dynamical aspect of the electronic excitation and its relaxation process at the surface. In this research project, we have determined the absolute total desorption yield at the surface of solid Ne, Ar, and Kr and have investigated the desorption of the excimer, Ne_2*.

V-H-1 Absolute Measurement of Total Photo Desorption Yield of Solid Ne in Vacuum Ultraviolet Range

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Absolute yields of photo-induced desorption at the surface of solid Ne have been measured between 25 and 100 nm of wavelength of incident light. There are strong dependence of the total desorption yield of Ne both on the excitation energy and on the thickness of Ne films. On a thick film, the desorption yield is 1–2 atoms/photon by the bulk exciton excitation and 2–10 atoms/photon by the bulk ionization. The main component in the desorbed species is neutral Ne molecules in the ground state; the absolute yield of metastable desorption at the excitonic excitation is the order of 10^{-3} metastable/photon.[1)] The absolute yield of the order of unity for the total desorption by the bulk exciton excitation can quantitatively be understood by the following internal sputtering model. From optical absorption data, the number of excitons created per photon per layer is estimated at about 0.1. The kinetic energies of the particles desorbed through the cavity ejection mechanism is about 0.2 eV and those by the excimer dissociation one 1 eV. Because the cohesive energy of Ne is 0.019 eV, the desorbing paticle, which is originated from the 2nd or 3rd layer, can blow 10 or more neutral Ne atoms in the overlayer off. The product of these values results in an order of unity of absolute yield of the total desorption. By the surface exciton excitation, the yield is 0.1–0.3 atoms/photon, which value means that the desorption probability of the surface exciton is almost unity.

Reference

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V-H-2 Desorption of Excimers from the Surface of Solid Ne by Low Energy Electron or Photon Impact

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If solid Ne surface is irradiated by 20–200 eV electrons or by 55–75 nm synchrotron radiation, Ne_2* excimers in $^3\Sigma_u$ state are desorbed to form a luminescent 'plume' in front of the sample. The kinetic energy of the desorbed excimers was found to be 0.2 ± 0.1 eV, which indicates that the cavity ejection mechanism[1)] is valid for the excimer desorption. The decay with time of the plume emission is not of single exponential type, because the emission lifetime of the desorbed excimers, which is of the order of 10^{-6} s, depends on their vibrational level. Most of them are in the highest vibrational level since desorption takes place much faster than vibrational relaxation.

Reference

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