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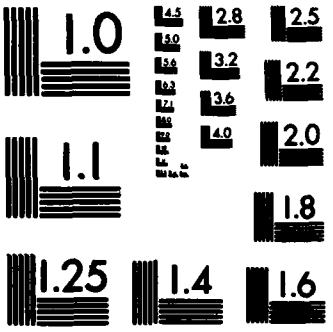

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PHOTON STIMULATED ION DESORPTION FROM CONDENSED CO AND N_2

By

H. Sambe, M. Yousif, and D. E. Ramaker

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Previously measured photon-stimulated ion desorption yields from condensed CO and N_2 surfaces are compared with the corresponding yields from gaseous CO and N_2. Upon condensation, substantial change takes place in both the N^+ and C^+ yields. The origin of this change is attributed to an electronic polarization of the solid surfaces.

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Photon-Stimulated Ion Desorption from Condensed CO and N_2

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Recently Rosenberg et al. [1] measured photon-stimulated ion desorption yields from condensed CO and N_2 surfaces and compared them with the corresponding yields from gaseous CO and N_2. Figs. 1a and 1b show such comparisons. Upon condensation, substantial change takes place in both the N^+ and C^+ yields. The origin of this change is attributed to an electronic polarization of the solid surfaces.

A positive ion created on the surface polarizes its neighbors and lowers its energy via an attractive charge-dipole interaction. This polarization energy must be overcome for the ion to desorb from the surface. One can mimic the ion desorption yield from the surface by applying a retarding potential equal to the polarization energy against the outcoming ions from the corresponding gaseous molecules. The solid curves in Figs. 1c [2] and 1d [3] are obtained by such an application of a 1.0eV retarding potential. Dotted curves in the same figures show the corresponding ion yields from gaseous molecules without the retarding potential. Despite the use of two different means (photons vs. electrons) for excitation, the essential features of Figs. 1a and 1b are reproduced in the corresponding Figs. 1c and 1d. This similarity between the gaseous yield with retardation and the solid yield suggests that the ion-yield change between the gas and solid phases is caused by the polarization barrier.

The polarization energy can be obtained either from the ion desorption threshold shift between gaseous and solid phases or comparison of the solid vs. gas phase, with retardation, ion-yield spectra. This energy appears to be about 1.0eV for solid N_2 and 1.5eV for solid CO and arises due to the surface polarization. The electronic polarizations are observed also in photoelectron spectra of condensed molecules. This polarization energy appears to be 0.9 - 1.5eV [5,6] for solid N_2 and 1.1 - 2.7eV [5,7] for solid CO and arises due mainly to bulk polarization. The surface polarization energy is expected to be slightly less than the bulk polarization energy, as observed.

Table 1 compares the ion-yield ratios, N_2^+/N^+ and CO^+/C^+, between the gaseous and condensed phases. The drastic reductions of the N_2^+/N^+ and CO^+/C^+ ratios upon condensation may also be due to the polarization barriers. The N_2^+ and CO^+ ions are created at thermal energy, which is two orders of magnitude smaller than the polarization energy. Therefore these ions are trapped at the surface. The decrease in the O^+/C^+ ratio upon condensation (Table 1) indicates that the O^+ ions have smaller kinetic energies relative to the C^+ ions. The O^+ ions are, indeed, expected to gain less kinetic energy than the C^+ ions, since the O^+ threshold is 2.4eV higher than the C^+ threshold.

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Table 1

Comparison of the ratios of photon-stimulated ion yields from gaseous and condensed CO and N_2.

Ion-yield Ratio[a)]	Gaseous[b)]	Condensed[c)]
N_2^+ / N^+	14.4	0.013
CO^+ / C^+	23.0	0.038
O^+ / C^+	0.55	0.038

a) The maximum ion yields for photon energies 14 - 35eV are used to calculate the ratios.

b) Obtained from Ref. [4]

c) Obtained from Ref. [1]

Figure Caption

Figure 1

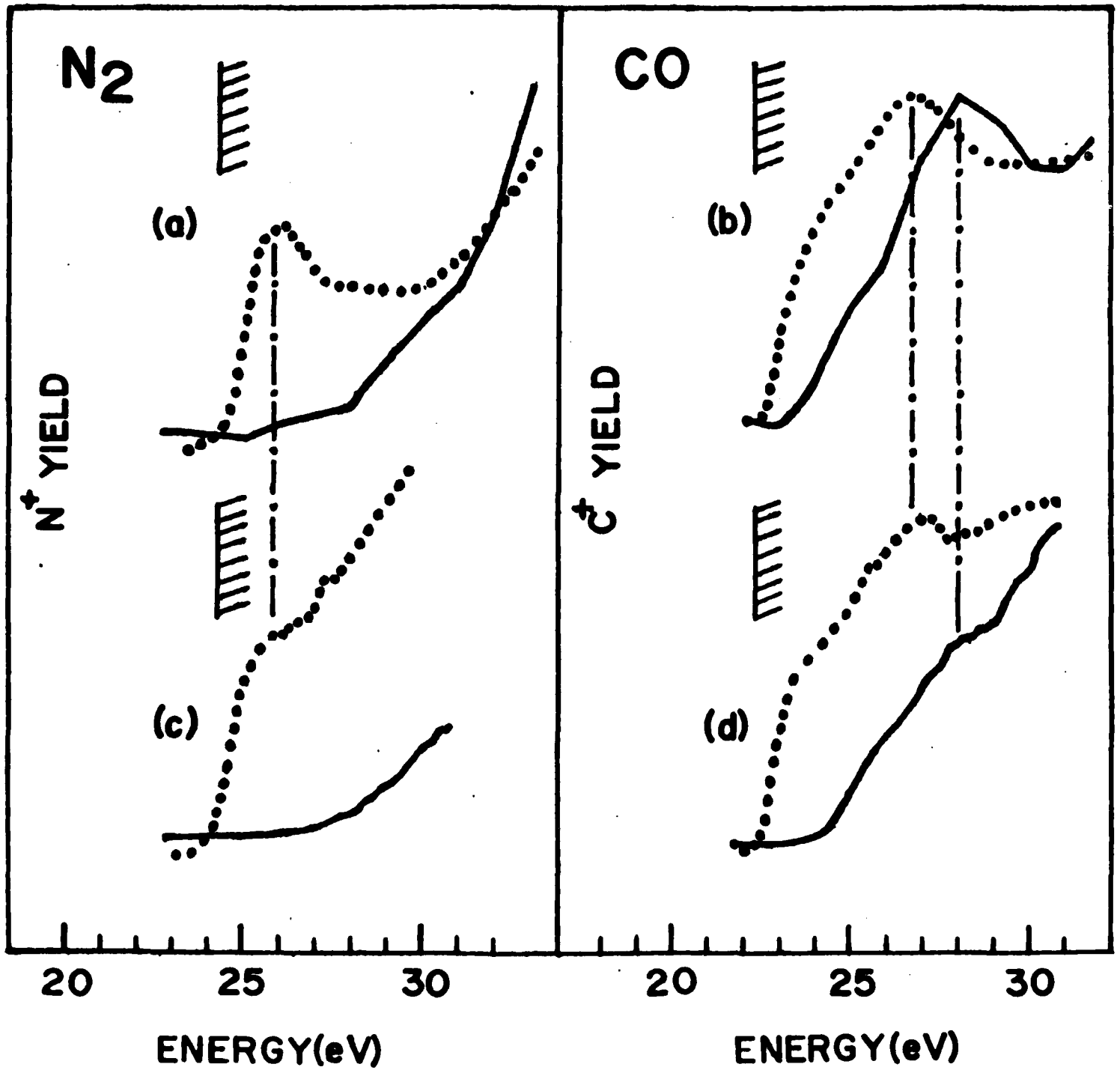
Comparison of N^+ and C^+ yields from N_2 and CO. The threshold energies for N^+ and C^+ from the gaseous molecules are indicated by lines with slashes. The ion yield scales have arbitrary units.

(a) The photon-stimulated N^+ yield from gaseous N_2 (dotted line) [4] is compared with that from condensed N_2 (solid line) [1].

(b) The photon-stimulated C^+ yield from gaseous CO (dotted line) [4] is compared with that from condensed CO (solid line) [1].

(c) The low-energy-electron-impact N^+ yield (from gaseous N_2) with no retarding potential (dotted line) is compared with that with a retarding potential V_R=1.0eV (solid line) [2].

(d) The low-energy-electron-impact C^+ yield (from gaseous CO) with no retarding potential (dotted line) is compared with that with a retarding potential V_R=1.0eV (solid line) [3].


N2
CO
(a)
(b)
(c)
(d)
N+ YIELD
C+ YIELD
20
25
30
ENERGY(eV)
20
25
30
ENERGY(eV)

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