ence[22] between states of the two configurations l^n and l^{n*}. It is not difficult to show[37] that

$$(\psi_f|\sum_{i=1}^{n} X_i|\psi_g)=(\Psi|\sum_{i=1}^{4l+2} X_i|\Psi)\delta_{fg}$$
$$+(-)^{1+k+p}(\bar{\psi}_f|\sum_{i+1}^{n^*} X_i|\bar{\psi}_g). \quad (4.27)$$

Here the operator X_i is of the type

$$X_i=R_{k\mu}(i)S_{p\nu}(i), \quad (4.28)$$

where $\mathbf{R}_k$ is a tensor of rank k operating on the spatial coordinates of particle i and $\mathbf{S}_p$ is of rank p acting on the spin ($p=0$, 1 for spin-$\frac{1}{2}$ particles). The symbol Ψ stands for a filled shell. Hence, the first term on the right of (4.27) is zero unless both k and p are zero.

It follows from the preceding that, for $n\geq 2l+1$,

$$Y_{20}{}^a(1)\equiv-(n^*/n)A(n^*)\mathcal{G}_{20}{}^a, \quad (4.29)$$

$$Y_{20}{}^a(1)s_\mu{}^a(1)\equiv+(n^*/n)[C_\mu{}^{(1)}(n^*)J_\mu{}^a$$
$$+C_\mu{}^{(3)}(n^*)\mathcal{J}_{3\mu}{}^a], \quad (4.30)$$

$$Y_{20}{}^a(1)\mathbf{s}^a(1)\cdot\mathbf{s}^b(1)\equiv(n^*/n)^2[D^{(1)}(n^*)\mathcal{G}_{20}{}^{ab}$$
$$+D^{(3)}(n^*)\mathcal{G}_{20}{}^{ab}]. \quad (4.31)$$

In (4.29), (4.30), and (4.31) we have indicated explicitly the dependence of the multiplying factors on the number of electrons. It enters into these factors via the submatrix elements of $\mathbf{Y}_2(1)$ and $\mathbf{s}_\mu(1)$ [also, via the factor $1/n$ in (4.16)].

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PHYSICAL REVIEW VOLUME 129, NUMBER 5 1 MARCH 1963

Potential and Kinetic Electron Ejection from Molybdenum by Argon Ions and Neutral Atoms

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(Received 29 October 1962)

The yield of secondary electrons γ_n, from cleaned surfaces of polycrystalline molybdenum has been measured for argon neutral atoms (Ar^0) in the energy range 500–2500 eV. The values of γ_n thus obtained are compared with γ_i, the yield for argon ions previously determined. It is found that the rates of increase of γ_i and γ_n with energy E are not equal in the region of kinetic ejection. The ratio $(d\gamma_i/dE)/(d\gamma_n/dE)$ is 1.5. The result indicates that assumed models concerning the respective contributions of potential and kinetic ejection to the secondary electron yield at energies above 1000 eV should be modified.

THERE is a small amount of data available on the secondary electron yields, γ_n, resulting from neutral atom bombardment on well-defined surfaces.[1,2] We report here the measurement of γ_n for Ar^0 on clean Mo surface in the energy range 500–2500 eV and its comparison with the secondary electron yield, γ_i, for ions of argon previously reported.[3] Our results and their interpretation differ from those of Arifov *et al.*[2] who have recently reported measurements of the Ar^+, Ar^0 on Mo system.

The apparatus utilized for the measurement of the neutral beam flux in the target chamber is shown in Fig. 1. Fast neutral argon atoms are produced by charge transfer of argon ions in argon gas. The neutral flux at the target is between 10–30% of the ion beam at the same energy. The neutral beam flux is measured directly by a movable thermocouple probe (P) which has been previously calibrated by the ion beam. Output of the probe is typically 250 μV/mW of beam power. In this calibration, it is assumed that the energy transfer coefficients for ions and neutrals of the same species at a given energy are identical. The detailed probe design and operation are to be reported separately. The surface cleaning of the Mo target and determination of monolayer formation time have been described previously.[3]

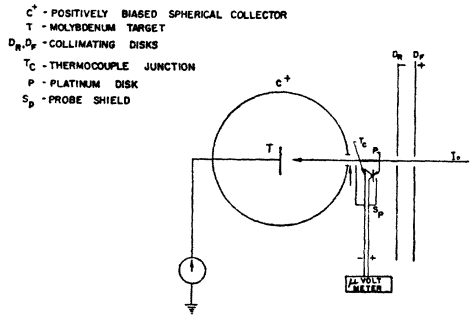

FIG. 1. Schematic of target-collector-movable probe system.

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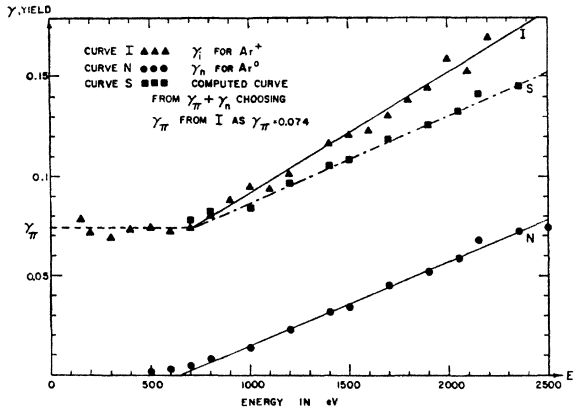

FIG. 2. Secondary electron yields for Ar^+ and Ar^0 on Mo.

The variation of the yield of secondary electrons with kinetic energy of the incident neutral particles is shown as curve (N) of Fig. 2. On the same figure we show as curve (I) the results for the variation of γ_i with energy. There is a divergence in the energy dependence of γ_i and γ_n above the "threshold" for kinetic ejection. This divergence is clearly apparent by comparison of the plots (I) and (S), where S is obtained by adding γ_n to γ_π; γ_π is computed from (I) as $\gamma_\pi \simeq 0.074$. It has previously been assumed[2,4] that for $E>1$ keV γ_π is independent of energy, i.e., $\gamma_i(E) = \gamma_\pi + \gamma_k(E)$, where $\gamma_k(E)$ is the electron yield due to the kinetic energy (E) of the incident ion. Arifov *et al.*[2] cite their results for Ar^+ and Ar^0 on Mo as evidence in support of this assumption. However, our results shown in Fig. 2 give slopes for the ascending part of the curves as

$$d\gamma_i/dE = 0.06/\text{keV} \quad \text{and} \quad d\gamma_n/dE = 0.04/\text{keV}.$$

It has been suggested that this observed divergence shows there is a dependence of potential ejection efficiency on energy, i.e., for Ar^+ γ_π increases with E. Comparative measurements of γ_i and γ_n for He should then exhibit an inversion of the behavior shown here for Ar since $\gamma_\pi(E)$ for He^+ is considered to be a decreasing function of energy.[5] Our measurements to date on the He^+, He^0 system have not clearly shown such expected behavior.

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PHYSICAL REVIEW VOLUME 129, NUMBER 5 1 MARCH 1963

Net Frequency of Ionization in Oxygen*

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(Received 27 August 1962)

A new microwave method for determining ν, the net frequency of ionization in a gas, has been developed and applied to oxygen. The determination is made from measurements of the formative time of a pulsed microwave discharge as a function of the time between pulses and from a knowledge of the rate of decay of the electron density in the afterglow of the discharge. Microwaves of 3.2-cm wavelength were used and the pressure of the oxygen was varied from 5 to 20 mm of Hg. Values of ν/p were determined for values of E/p from 36 to 62 V cm^{-1} (mm Hg)$^{-1}$. The results from the microwave experiment agree well with dc data.

1. INTRODUCTION

SEVERAL experimental methods have been developed to measure the net frequency of ionization, ν, in a gas[1,2] in which a knowledge of the electron diffusion coefficient either at low electron densities or throughout a range from low to high electron densities is required. If the ambient electron density is maintained at a relatively high value throughout the experiment the diffusion losses are by ambipolar diffusion and under certain conditions can be made negligible compared with other losses. In the present experiment a pulsed microwave source is used to produce the electrons. The net frequency of ionization is determined from measurements of the formative time of a "steady state" pulsed microwave discharge as a function of the time between pulses and from a knowledge of the rate of decay of the electron density in the afterglow of a microwave discharge. The term "steady state" implies that the electron density repeats its cycle with each incident microwave pulse. The formative time τ is the time taken for the electron density to build up from some initial value n_0, that is present at the arrival of the microwave pulse to some convenient larger value n_b. For simplicity the upper value is taken to be that which produces a large attenuation and a large reflection of the incident microwave power used to produce the electron density.

* This work is supported by the Physics Technology Department of the Boeing Airplane Company.
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