0.73 g/cm². The intensity of the neutron beam was calibrated each time by a copper monitor, whose activity was measured with a pressure ionization chamber; the activity of the detector was measured with a Geiger-Mueller counter. No noticeable scattering from the room could be detected.

The results of these measurements were: neutron-carbon cross section 1.13×10^{-24} cm², neutron-proton cross section 0.61×10^{-24} cm².

The theoretical neutron-proton cross section was then evaluated from the phase shifts, according to the theory of Faxen and Holtsmark,[3] with 2.17 Mev for the binding energy of the deuteron, a rectangular well and a range of 2.81×10^{-13} cm. The contribution of the antiparallel spin orientations was calculated with a depth of well 11.7 Mev, obtained by Breit (private communication) from the scattering of slow neutrons. The contribution of the parallel spins was calculated with 20.4 Mev for the depth of the well. The total calculated cross section came out to be 0.61×10^{-24} cm², in satisfactory agreement with the measured value.

The details of these and other measurements will be given later.

E. O. SALANT*
R. B. ROBERTS†
P. WANG‡

Department of Terrestrial Magnetism,
Carnegie Institution of Washington,
Washington, D. C.,
April 25, 1939.

* Washington Square College, New York University.
† Carnegie Institution Fellow.
‡ China Foundation Fellow.

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Phenomenon of Secondary-Electron Emission

Recently published results on secondary-electron emission indicate that the high secondary-to-primary ratios, δ's, previously reported for electropositive metals are characteristic of contaminated rather than clean surfaces. Bruining and de Boer[1] report that for uncontaminated surfaces the maximum δ is very low while for oxidized surfaces it is very high. Thin oxidized films of Ba and Li on a metal base, for instance, give maximum values of δ of 4.8 and 4.2, respectively.[1]

It has occurred to the writer that the existence of a positive charge in surface films of this type may be an important factor influencing their secondary-electron emission characteristics. A positive charge produced in the insulating layer as a result of the primary-electron bombardment may give rise to an intense electric field through the film. Though the dielectric strength of this type of film is not great enough to support fields of sufficient intensity to give rise to thin-film field emission,[2] it may support fields strong enough to increase materially the probability of escape of the secondary electrons produced within the layer and in the base metal.

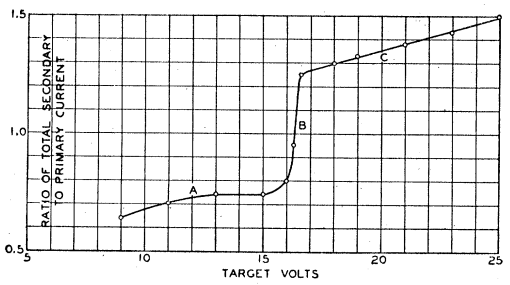

FIG. 1.

In accordance with the hypothesis advanced above, it is to be expected that a curve of δ as a function of primary-electron velocity for the type of surface under consideration should show a definite break in the region of low potentials corresponding to a transformation from negative to positive charge in the insulating film. The film should be negatively charged as long as the δ for its outermost layers remains less than unity and it should become positively charged when this δ becomes greater than unity as the velocity of the primary electrons is increased. When the δ becomes greater than unity, a sudden increase in the secondary emission should result.

An experiment, therefore, was performed to determine δ as a function of the velocity of the primary electrons in the region of low potentials for a film of MgO on Nichrome. The film (about 1000 angstroms thick) was evaporated onto the Nichrome surface in vacuum from a MgO-coated platinum filament. The total secondary emission (true secondaries plus reflected electrons) was determined as a function of the voltage of the MgO-Nichrome target, when the electric field drawing the secondaries from the surface was 100 volts per cm. The curve shows definitely three regions *A*, *B* and *C* corresponding, respectively, to conditions where the charge is negative, where the charge changes from negative to positive, and where the charge is positive and in a state of equilibrium. In regions *A* and *C* the secondary-electron emission remains substantially constant with time while in region *B* it increases with time when readings were taken from low to high potentials and decreases with time when readings were taken in the opposite sense. At the beginning of region *B*, a regenerative action evidently sets in. A positive charge is produced in the outermost layers of molecules which assists the escape of a greater fraction of the secondaries generated within the films, more positive charge is produced, and in turn more secondaries escape, and so on until an equilibrium condition is produced.

At higher voltages, δ varied normally with the potential. A maximum δ of 5.4 was reached at about 400 volts. Neither instability nor thin-film field effects were observed.

HERBERT NELSON

Research and Engineering Department,
RCA Manufacturing Company, Inc.,
Harrison, New Jersey,
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