Drift of Adsorbed TH on W Filaments Heated with d.c.

A study (soon to be reported) of the surface structure produced on tungsten lamp filaments during long heating with direct current has suggested that W ions drift over the wire surface toward the negative terminal. Such migration can be demonstrated directly, for the case of Th adsorbed on W, in a simple electron-optical tube.

A loop of 1 mil thoriated wire 6 mm long is mounted on 30-mil leads at the center of a spherical bulb 3 inches in diameter coated inside with willemite. The anode, a wire ring near the mouth of the bulb, is made a few thousand volts positive, and the emitted electrons form on the screen a magnified orthogonal image of the loop; the screen is kept near anode potential by secondary emission. A 10-mil Ni wire, welded to one filament lead and projecting between the ends of the loop, casts an electrical shadow which permits distinguishing the emission from the two ends, and also prevents evaporation of Th from one end across to the other. With the anode floating, the filament is first flashed and then is heated, from a 2 v d.c. supply, for 20 or 30 minutes at a low activating temperature. The electron image, observed briefly at a low temperature where Th is immobile, is then brightest opposite the negative end of the loop, with a sharp cutoff toward the lead and a gradual decrease toward the center. The positive side of the screen is dark. With 60-cycle a.c. heating, the activation is always symmetrical about the center of the wire. These observations have been repeated in a similar tube, with a loop of 2 mil thoriated wire.

The processes involved in activation of a short filament are obviously manifold, but the net result, that Th accumulates preferentially at the negative end, strongly indicates a drift of ions in the electric field. Ionization in the space is ruled out by the low voltage of the heating supply, the shadow-caster stops evaporation from one end to the other, and thermionic emission from either end is at the worst limited by space charge to a value too low to give appreciable cooling.

This experimental arrangement is not adapted for yielding values for either the mobility or the activation energy for migration under the influence of a field. Deposit of Th on an isothermal length of smooth undoped filament (preferably a single crystal), by evaporation from an external source, at present seems a promising technique for future study of the effect.

R. P. Johnson

Research Laboratory,
General Electric Company,
Schenectady, New York,
April 6, 1938.

On the Form of the β-Spectrum of Ra E in the Vicinity of the Upper Limit and the Mass of the Neutrino

The spectrum of the β-particles emitted by Ra E has often been studied and at the present time[1] it is established that the form of the spectrum over a wide range may be accounted for satisfactorily by the formula of Uhlenbeck and Konopinski. However the spectrum in the immediate neighborhood of the upper limit has been studied in much less detail. Nevertheless the results of Lyman's[2] measurements and those described in this note indicate that the form of the spectrum in this region departs considerably from that predicted by theory. The study of the energy distribution of the electrons in the neighborhood of the spectral limit is for a number of reasons accompanied by considerable difficulty, chief of which is the low intensity of the radiation in this part of the spectrum. The choice of apparatus and the sensitivity of the method of registering the electrons are therefore of prime importance. In the experiments described below, the method of electron focusing in a uniform magnetic field has been used. The electrons were registered by the method of coincident discharges in Geiger-Müller counters. It was necessary to guard against electrons scattered from the walls of the apparatus and from the diaphragm entering the counters. This was attained by separating out a narrow beam of electrons ($\phi=10°$) and by a special system of traps.

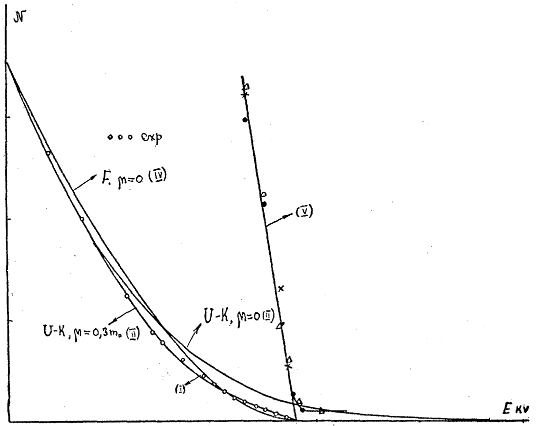

Fig. 1.

By placing the first counter with its narrow slit at the focus it was possible to eliminate almost completely the entry of scattered electrons. The source was a thin nickel strip on which 0.3 – 1.0 mC of Ra E were deposited. The spectrum was studied in detail from $E=1030$ kv to $E_m=1180$ kv. The results are represented in Fig. 1(I) and it will be seen that the energy intervals were very narrow. The random error of the individual points on the curve were very small and the measurements of the magnetic field constitute the main error. A noticeable feature in Fig. 1 is the sharp change in the curve at an energy of about 1120 kv after which the number of electrons decreases practically linearly. This part of the curve is reproduced on a larger scale in the same figure for the sake of clarity (V). The results of repeated experiments are indicated by different signs. The insignificant number of electrons observed at $E>E_m$ is undoubtedly due to scattered electrons and indicates that the experimental conditions were satisfactory.

The spectra computed according to the formula:

$$P\sim W\cdot(W^2-1)^{\frac{1}{2}}\cdot(W_0-W)^3\cdot[(W_0-W)^2-(\mu/m)^2]^{\frac{1}{2}}\cdot f(Z,W).$$

which follows from the theory of Konopinski and Uhlenbeck are given in Fig. 1. Curve II refers to the case $\mu=0$