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# INFLUENCE OF ACCELERATING FIELDS ON THE PHOTO-ELECTRIC AND THERMIONIC WORK FUNCTION OF COMPOSITE SURFACES

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**Influence of Accelerating Fields on the Photoelectric and Thermionic Work Function of Composite Surfaces.**

With an accelerating potential of 22.5 volts, Ives and Olpin (Phys. Rev. **34,** 117, (1929)) found that the long wave-length limit of an alkali metal film on platinum progressed toward the red as the film thickness increased, reached a maximum and then receded when the film was made very thick. Experiments by the writer with a twenty volt accelerating potential confirm this result with the exception that the long wave-length limits observed were more than 1000 Angstrom units farther into the infra-red than those reported by Ives and Olpin. Although there is an optimum film thickness, as pointed out above, when an accelerating field is applied, such is not the case at *zero field*. Lowering the accelerating field causes the optimum thickness to increase until at zero field the long wave-length limit has been observed to change progressively from that of the background metal to that of the alkali metal *without a maximum excursion* and regression.

This investigation has also been carried over into the field of thermionics using a type *T* thoriated tungsten filament with a small carbon content. With an activation temperature of 1920°K, a test temperature of 1230°K and a test accelerating potential of 20 volts, the thermionic current increased to a maximum of $98\times10^{-6}$ amp. per cm$^2$ at the end of 90 minutes activation. This time of activation had produced the optimum thickness. With continued activation the thermionic current decreased until at 280 minutes an equilibrium condition was produced with a current of $59.3\times10^{-6}$ amp. per cm$^2$. This observation is thus exactly analogous to that reported for the photo-electric effect. Judging by abstract 62 of the forthcoming meeting at Washington this phenomenon has also been observed by W. H. Brattain who deposited the thorium on tungsten from an external source but made no mention of the importance of the accelerating field. In order to prove that an excess film thickness had caused the decrease in emission described above, the activation temperature was raised and the emission was observed to *increase* with time of activation reaching new equilibrium values for each temperature. At a temperature of 2085°K the rates of evaporation and diffusion were so balanced as to keep the surface covered to just the optimum thickness for maximum thermionic emission which was $98\times10^{-6}$ amp. per cm$^2$. Further increase in temperature reduced the thermionic emission indicating that the equilibrium condition of the surface corresponded to a film thickness less than the optimum. Tests with *lower* accelerating potentials showed that the optimum thickness depended on the test potential and moved toward thicker films as the potential was decreased until at practically zero field the maximum emission of $40.5\times10^{-6}$ amp. per cm$^2$ was attained after 200 minutes of activation at 1920°K and practically no decrease in emission was produced by continued activation. These experiments, showing such close relationships between the thermionic and photoelectric behaviour of thin films, lend support to the theory that the "thermionic" and "photoelectric" electrons in these experiments come from the same family, presumably the "free" electrons.

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