ELECTRON EMISSION FROM METALS AS A FUNCTION OF TEMPERATURE; ADDED NOTE

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ABSTRACT

Recent very accurate measurements on the emission from filaments suggest that the constant A has the same value for all pure crystalline substances such as pure W, Mo and Ta, but is less for thoriated tungsten, caesiated tungsten and oxide covered platinum. This apparent disagreement with theory is briefly discussed.

THE subject of thermionic emission must always be associated with the name Professor Richardson, and his contribution on the historical development of an equation for electron emission is, therefore, of great interest. (See preceding paper.)

Naturally, it seemed unnecessary for the present writer to enter into a full historical discussion in a paper which was mainly concerned with the development of what appeared to be a significant relation between the evaporation of monatomic substances and of electrons.

It may be mentioned in this connection that as a result of a series of very accurate measurements on the emission from thoriated tungsten filaments the writer has been led to the conclusion that the value of the universal constant A, previously derived, is valid only for pure crystalline substances. Thus, for pure tungsten, molybdenum and tantalum, the value of A is found to be experimentally in agreement with the value of 60.2 amp/cm^2 deg.^{2} On the other hand, for fully activated thoriated tungsten the constant has approximately one tenth the above value and increases as the layer of thorium is removed. Similar results have been observed by Kingdon in the case of caesiated tungsten filaments and there is no doubt that the value of A for platinum covered with oxides is also very much lower than that deduced by the writer. This apparent disagreement with the theory is, however, undoubtedly accounted for in the light of G. N. Lewis' interpretation of the third law of thermodynamics. According to the latter the entropy at $T=0$ is zero only for pure crystalline substances, for which the thermodynamic probability is unity. However, for substances in which the atoms are not regularly arranged in a lattice the probability is greater than unity and the entropy must, therefore, be greater than zero. From these considerations it follows that for the latter class of substances the value of the constant A should be smaller than that given above. The full details of the measurements with thoriated tungsten and a discussion of their significance will be published in the near future.

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