energy of a metal. Their result is

$$E_{F1} - E_{F0} = (3.7/\Delta')(e^2/r_d) \quad (4)$$

in which Δ' is the ratio of the lattice period of the metal to the radius of the first Bohr orbit.

Equation (4) may be incorporated into either Eq. (1) or Eq. (2) to yield a more complete first-order expression for W_Z or W. Consider the combination of Eqs. (2) and (4); the resultant expression is

$$W = e\varphi_w + [\tfrac{3}{8} - (3.7/\Delta')]e^2/r_d + Ze^2/r_d \quad (5)$$

The importance of the quantity $(3.7/\Delta')$ can be assessed by computing its value for a particular metal. For example, the value of $3.7/\Delta'$ for potassium ($\Delta' = 8.0$) is 0.46, which is not only the same order of magnitude as $\frac{3}{8}$ but is actually larger and opposite in sign. Thus, for a neutral potassium droplet, the value of $(W - e\varphi_w)$ is $-0.09(e^2/r_d)$ instead of $+\frac{3}{8}(e^2/r_d)$.

Because of lack of direct data on the possible variation of droplet work function with droplet size, we are not able to confirm Eq. (5). However, there is evidence that Eq. (4) is quite reliable. This evidence is drawn from the theoretical work of Brager and Schuchowitzky[5] on the surface tension of molten metals.

It is well known that the surface tension of molten metals is much higher than that of the liquids. Brager and Schuchowitzky showed that such a high surface tension can be adequately explained on the basis that the dispersion of a metal results in an increase in the kinetic energy of the electrons in the metal. They were able to obtain reasonably good correlation between their computed values and the experimental values of surface tension for 12 (Na, K, Cu, Ag, Au, Zn, Cd, Hg, Sn, Pb, Sb, and Bi) of the 14 metals they considered.

The success of Brager and Schuchowitzky's theory, even though moderate, implies that Eq. (4) is probably quite correct. The basis for citing this implication may be found in Refs. 4 and 5. A close reading of these two papers will show that identical physical model and identical method were used to derive the basic equation for calculating the Fermi energy in Ref. 4 and the surface tension in Ref. 5. Because of this similarity in the basic approach to the theory of surface tension of molten metals and to the theory of Fermi energy of metal droplets, experimental confirmation of the surface tension theory in Ref. 5 may be taken to imply that the theory of Fermi energy of metal droplets as presented in Ref. 4, and consequently Eq. (4) of this comment, is basically correct.

It is interesting to note the variation of W with r_d as predicted by Eq. (5). By calculation one easily can show that the quantity $(\frac{3}{8} - 3.7/\Delta')$ is generally negative. Thus, for a neutral droplet the value of W is generally less than $e\varphi_w$ and varies inversely with r_d. Obviously, as r_d approaches the atomic radius, additional terms must be added to Eq. (5), so that W will approach the ionization energy I of a single atom. Since $I > e\varphi_w$, it is quite probable that the variation of W between I and $e\varphi_w$ will show a minimum at some value of r_d. Such a possible dependence of W on r_d is remarkably similar to the reported dependence of the photoelectric work function of thin films on film thickness.[6–8] Data in these references showed that, in thin films of aluminum,[6] silver,[6] gold,[7] and magnesium,[8] there was a characteristic thickness that yielded a minimum photoelectric work function. This minimum value was found to occur at 530 Å for Al, 80 Å for Ag, 52 Å for Au, and 230 Å for Mg.

In conclusion, it may be pointed out that in applying Eq. (5) to metal droplets, one should bear in mind that it is only a first-order equation, and as such it cannot be counted upon to hold for r_d smaller than a certain lower limit. However, within the framework of applying Eq. (5) as a first-order equation, we believe it is more complete than either Eqs. (1) or (2).

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Comments on "Physics of Meteor Entry"

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In her recent review paper on meteor physics, Romig writes (Ref. 1, p.392): "Studies in recent years, summarized in Ref. 21 (Ref. 3 of this Comment), show that the luminous efficiency factor can vary by more than two orders of magnitude. Some of this is due to differences in meteoroid composition and shape, but some is undoubtedly due to fragmentation and gas radiation." A similar statement is made also on p. 388: "The uncertainty in [the luminous efficiency factor] τ_0 (due primarily to composition and fragmentation) can be as large as two orders of magnitude"[16] (Ref. 16 is Ref. 4 of this Comment).

It must be pointed out that the uncertainty in the luminous efficiency is now much smaller, though it was indeed two orders of magnitude in 1959 and even later. After the experiments with artificial meteors[2] and my work[3] on Jacchia's precisely reduced photographic meteors, the uncertainty in τ_0 is of the order of two, as explicitly stated in Ref. 3. In conclusion, the meteor masses computed from the so-called luminosity equation have an uncertainty of a factor of two and not of two orders of magnitude; therefore, "the empirical approach of the Smithsonian group," to use Romig's words, is much more reliable and sound than it appears from Romig's conclusions.

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