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HALL EFFECT AND SPECIFIC RESISTANCE IN EVAPORATED FILMS OF SILVER, COPPER AND IRON

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Previous investigators have found the specific resistance a constant for metallic films, until the thickness becomes comparable with particle dimensions, at which thickness the resistance becomes very great. Wait[1] found the resistivity of chemically deposited silver films, whose thicknesses were greater than the above mentioned critical thickness, to be only slightly greater than that of the bulk metal. He found the Hall effect in these films, as well as in films whose thicknesses were less than the critical thickness, to be the same as that of bulk silver. On the conception that the substance in a film consists of granules not in the intimate contact obtaining in the bulk form, these results could be accounted for. Consequently it became desirable to investigate silver films obtained by an evaporation method, in order to ascertain how they differ from chemically deposited films, and how these differences affect their properties.

Evaporated films are obtained by carrying an electrically heated filament of the metal back and forth over a glass microscope slide in high vacuum. The filament when sufficiently hot ejects particles of metal which adhere to the slide, giving a hard uniform film. The surfaces of these films reflect very well without the aid of artificial polishing. No trace of structure is visible under the microscope. Hull's method of X-ray analysis shows lines similar to those in the bulk metal, from which it is inferred that the films are crystalline, the elementary crystal being of the same type as that found by Hull for the respective bulk metals. It is thought that the films possess a very fine grain.

The resistivity of evaporated films is much greater than that of the bulk metal, in the case of copper and silver about 1000 per cent. Also the critical thickness for evaporated silver films is less than that for chemically deposited silver films.

The Hall coefficient for evaporated silver and copper films is only slightly less than that for the bulk metal, whereas for evap-

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orated iron its value is from 600 to 1000 per cent greater than that for pure bulk iron.

These phenomena are interpreted as a consequence of the small granules in evaporated metals, in the following way:

1. The effect of granular boundaries is to increase the resistance of a specimen.

2. The current contributing to Hall effect is decreased upon increasing the number of gaps in any cross section.

3. The Hall effect depends upon the magnetic condition of a substance, which in turn depends upon the granular dimensions.

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