Journal notes

Ice Energy

During the two hundred years following Franklin's discovery of the electrical nature of thunderstorms, many different mechanisms were suggested for the process of electrical charge generation in such storms. Investigators at the New Mexico School of Mines, believing that no one of these proposals could be modified to explain all the observed properties of thunderstorms, initiated a search for some new physical process which might be employed for electrical charge generation in nature.

Laboratory tests set up to simulate the environment of the storm generator were productive of a rather spectacular device. It was found that if dilute aqueous solutions (10^{-6} to 10^{-3} normal) of simple salts were frozen in an "orderly" manner, relatively large potential differences were generated between the ice and the remaining liquid. The polarity, magnitude, and general character of the potential difference depend upon the nature and concentration of the contaminant. The effect results from the growth of the ice crystal and involves the transport of readily measurable electric currents—approximately one micro-ampere when weak solutions of sodium fluoride freeze at the rate of 1 cc per second. In general, the stronger solutions give lower potential differences (10 to 40 volts), and the measurable current is relatively large. The weak solution of ammonium hydroxide, on the other hand, generated a potential difference as great as 235 volts when freezing.

Preliminary determinations have indicated that thunderstorm water has impurities of character suitable to generate charges of the right sign and magnitude to make thunderstorm electricity when glaze hail is formed. It has been suggested that such process of freezing in the laboratory might be useful in procedures for micro-analysis and that on the surface of the earth natural freezing might be productive of significant geophysical effects.

E.J.W.

Electrical Phenomena Occurring During the Freezing of Dilute Aqueous Solutions and Their Possible Relationship to Thunderstorm Electricity. By E. J. Workman and S. E. Reynolds. *Phys. Rev. 78: 254, May 1, 1950.*

Thin Metal Films

The physical properties of evaporated metal films cannot in general be explained in terms of the bulk metal: it is usually necessary to assume an aggregated structure, particularly in the case of films less than 150 Angstroms in thickness. The electron microscope provides direct information on the nature of the aggregation in the films and so permits at least qualitative predictions of their properties.

Optical transmissions, reflections, and absorption for films of a number of metals have been determined and related to their observed structures. For some metals, e.g. silver and gold, the variation in the absorption with thickness shows a distinct maximum at the thickness for which the aggregates began to merge. For other metals, e.g. antimony and nickel, which also have an aggregated structure, the absorption merely increases continuously with thickness. All the results can be satisfactorily explained in terms of the different optical constants of the bulk metals and the aggregation which occurs in the films.

It was found that the rate of evaporation has an important effect on the structure and hence the properties of the films. Other conditions remaining the same, films formed at slower rates displayed increased agglomeration, especially in the thicker films. This increased agglomeration explains, for example, why a silver film 300 Å thick has 40 percent absorption for red light when evaporated in 75 minutes, but only 1 per cent when evaporated in 2 seconds. Hence for high quality reflection coatings such as required on interferometer plates, a rapid evaporation of the metal is desirable.

G.D.S.

The Structure of Evaporated Metal Films and Their Optical Properties. By R. S. Sennett and G. D. Scott. *J. Opt. Soc. Am. 40: 203, April, 1950.*

Magnetic Resonance

The precession of the electron spin in a strong magnetic field causes ferromagnetic solids to have a "magnetic resonance spectrum", which is observed by applying a weak alternating measuring field at right angles to the strong constant field. The resonance maximum, however, is not located at the frequency predicted by theory if one identifies the *effective* field with the *applied* field. This is because the dipolar interactions responsible for the demagnetization corrections make these factors differ. The appropriate formula for the effective field has been developed by Kittel by using macroscopic classical mechanics.

In the first part of the present paper an alternative derivation is given from the microscopic standpoint by means of quantum mechanics. Kittel's anistropy corrections are also derived in this fashion. Even when Kittel's formula is employed, the resonance frequency is not properly represented unless the Landé factor g is given anomalously high values as compared with those obtained from experiments on rotation by magnetization.

Various physicists have pointed out that conceptually the two types of g-factors are not the same; they may conveniently be called the spectroscopic splitting factor and the gyromagnetic ratio, denoted by g and g′ respectively. The particular relation between g and g′ given by Kittel for a special model has been derived more generally, although the observed values of g in ferromagnetic resonance experiments are actually too high to conform to this relation. The paper speculates as to possible causes of this anomaly, and of the width of the magnetic resonance lines, a subject imperfectly understood at present.

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Concerning the Theory of Ferromagnetic Resonance. By J. H. Van Vleck. *Phys. Rev. 78: 266, May 1, 1950.*