Digital Computer Laboratory
Massachusetts Institute of Technology
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SUBJECT: CONFERENCE ON THIN EVAPORATED METAL FILMS

To: David R. Brown

From: Arthur L. Loeb

Date: October 6, 1952

Abstract: A meeting was held by representative of Group 63, Project Whirlwind, Group 35, Project Lincoln and the Chemistry Department to coordinate research on thin metal films. M. I. T. appears to have all the facilities for the controlled manufacture and an extensive investigation of the properties of thin metal films. Considerable work has already been done here, and all three groups represented are interested in pooling resources for continued and extended research.

On Wednesday, October 1, a meeting was held in Professor Harris' office to discuss coordination of research on thin evaporated metal films. The following were present:

Prof. Louis Harris and Dr. Arthur L. Loeb of the Chemistry Dept.
Dr. Louis Gold of Project Lincoln, Group 35
David R. Brown, Dudley A. Buck and Arthur L. Loeb of Project Whirlwind, Group 63.

The three groups represented are all interested in research on thin metal films, and it is felt that Professor Harris' experience in making these films and making measurements on them could be used to good advantage by all. At present, a manpower shortage in the Chemistry Laboratory keeps the rate of film production down; the other two groups will try to assist in relieving this shortage. Professor Harris does not require people already trained in film evaporation, but would like someone with a Bachelor's degree or equivalent training.

The following topics in thin film research appear of interest:

A. Semiconductor characteristics of:

1. Metal smokes (Gold, etc.)
2. Germanium brights
3. Alloys

It should be explained here that when metal brights are prepared by evaporation in vacuo, the pressure should be less than 10^{-4} mm. When the pressure in the evaporation chamber is several millimeters (inert gas), a metal smoke is obtained, i.e. a metal film of very low density (about $\frac{1}{400}$ x density in solid state). These topics are of special interest to Project Lincoln's Group 35.

B. The use of bismuth and perhaps antimony films in microwave filters and switches.

Films of ferromagnetic materials might also be considered. Again, Project Lincoln's Group 35 is particularly interested. See also, however, under C.

C. The properties of thin films of ordinarily ferromagnetic materials, e.g. iron, permalloy and Heusler's Alloy.

The preparation of small cores by evaporation was discussed, and in principle found feasible. At first a matrix array of only four elements would be made, each core having the dimensions 1/16 in. ID, 1/8 in. OD. Project Whirlwind, Group 63, is particularly interested in this and could provide the masks for preparation of these cores.

D. The ferroelectric properties of thin films of materials like tungsten trioxide and barium titanate, which exhibit ferroelectric properties in bulk form.

Both groups 35 and 63 are interested in this.

E. The properties of thin films ordinarily electroluminescent materials like zinc sulphide and cadmium sulphide. Group 35 is particularly interested in this.

F. The magnetoresistance of bismuth and germanium films and their optical (infrared) transmissions.

All groups concerned have expressed an interest in this.

G. The independent measurements of the Hall effect and electron mobility of these films.

These measurements can be made by Project Lincoln's Group 35, and is of special interest in the fundamental thin films research carried out by Professor Harris' Group (see under I).

H. Microwave reflection and transmission of thin films.

Some of these measurements have previously been carried out for Professor Harris by L. D. Smullin, now of Division 4, Project Lincoln.

I. Besides the manufacture of metal films, which is necessary but of subsidiary interest to the Chemistry group, Professor Harris has been engaged in the measurement of their optical characteristics (visible and infrared transmission and reflection), and their correlation with electrical resistance and thermoelectrical effects. This research has been in progress for years, and is considerably assisted by the Office of Naval Research.

J. Dr. Loeb (now 55% in Group 63, Project Whirlwind), has been working with Professor Harris on the correlation between the optical and electrical

properties of metal smokes and metal films. Through the cooperation of the Office of Naval Research, Dr. Loeb has coded and tested a number of programs for WWI and has already obtained very useful results. Upon completion of the modifications in WWI, this work is expected to continue; at this time, prospects look very bright for large returns on the time already spent on this project. The helpful collaboration with Group 6345, Project Whirlwind, and the able assistance of Donna Neeb of that group are gratefully acknowledged here.

In conclusion, then, it appears that M. I. T. now possesses the facilities for the controlled manufacture of thin films (Chemistry Dept.), optical measurements on these films (Chemistry Dept.), mathematical evaluation of the data (WWI Computer), Hall effect measurements (Group 35), Electron Mobility measurements (Group 35), Magnetic measurements (Group 63), etc. Thus each sample could conveniently be examined inevery relevant manner, and the results coordinated by the recorded conditions of manufacture.

Signed Arthur L. Loeb
~~Arthur L. Loeb~~

Approved DRB
David R. Brown

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