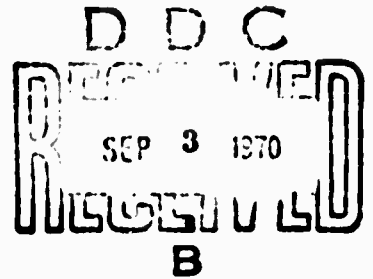


AD 711221

September 1, 1970

Research on
Contacts Between Chalcogenide Glasses, Metals
and Semiconductors

sponsored by the
Advanced Research Projects Agency
ARPA Order No. 1562



Quarterly Management Report

Program Code No. 61101D
Contractor: Pennsylvania State University
Effective Date of Contract:
June 1, 1970
Contract Expiration Date:
May 31, 1971
Amount of Contract: \$41,666.06

Contract No. DAHIC0470C 0047
Principal Investigator: H. K. Henisch
Telephone: 814-865-1194

Materials Research Laboratory
The Pennsylvania State University
Engineering Sciences Building
University Park, Pennsylvania 16802

APR 1971

The Director
Advanced Research Projects Agency
Washington, D. C. 20301

Attention: Program Management

Contacts Between Chalcogenide Glasses, Metals
and Semiconductors

The two main purposes of the research here described are to elucidate the mechanism of threshold switching and to explore new device possibilities through the use of contact materials which can be electronically altered in situ.

During this first quarter of the contract period the work has consisted of two parts: one concerned with the preparation of facilities for glass film deposition on graphite and germanium substrates, and one with measurements on existing threshold switches. The preparatory work has progressed to the point at which the first film depositions by vacuum flash evaporation can take place. Of course, the detailed conditions will have to be optimized in order to achieve reliable film systems suitable for electrical measurements. Low frequency test facilities have also been set up and are ready for use. A cathode of threshold switching material has been provided by Energy Conversion Devices, Inc., for use in an existing sputtering system. This should eventually permit a systematic comparison between sputtered and flash evaporated films made from the same starting material.

The pulse measurements (which have been in progress for some months) aim at clarifying the role of thermal processes in threshold switching. There is certainly a body of opinion that holds heating solely responsible for threshold switching. Even if this were incorrect (as the

writer and his group believe) it is inevitable that a certain amount of heating should take place, and since all the materials involved are temperature sensitive, this aspect can never be neglected. Indeed, thermal interpretations have been shown to be plausible for thick (e. g. $>10\mu$) switching systems. However, the crucial point here is whether heating by itself causes threshold switching in thin layer systems or whether distinctive electronic processes play an essential part. The preliminary findings (still subject to confirmation when measurements are repeated with better pulse generators than now available) indicate that heating alone does not provide an adequate explanation. It is known, for instance, that a threshold switch has a short-term memory of a previous operation, lasting for a period of about 2-3 microseconds. Within this period (following a previous switching cycle) the threshold voltage is lowered. By means of a double pulse procedure here developed, such measurements can be made for varying power levels of the preceding pulse. They have tended to show that whatever the second pulse "remembers", it is not the power dissipation of the first. If this is correct, then the remembered post-switching condition must be electronic in character. These matters are now being pursued in greater detail. They are at the root of the threshold switching problem. The same pulse techniques will be used on locally made film systems as soon as these become available.

In addition to the Principal Investigator, one half-time Graduate Assistant (Mr. R. Pryor) was employed on the contract, and another (Mr. G. Vendura) also involved. Dr. S. Lee, a graduate of this laboratory and lately at the University of Southampton, England, has accepted an appointment as Research Associate, as from September 1, 1970.

Fiscal Status

1. Amount currently provided for the contract: \$41,660.06
2. Expenditures and commitments through August 31, 1970:
 - a. Salaries and wages \$2,324
 - b. Indirect costs 1,369
 - c. Supplies and materials 110
 - d. Auxiliary services nil
 - e. Other costs 264
 - f. Equipment nil

\$4,067
3. Estimated funds required to complete this work: \$37,599.00
4. Estimated date of completion of first stage: May 31, 1971.
(Work planned on three year basis.)