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ENGINEERING EXPERIMENT STATION
of the Georgia Institute of Technology
Atlanta, Georgia



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STATUS REPORT NO. 33

PROJECT NO. 116-18

INVESTIGATION OF FUNDAMENTAL PROPERTIES
OF
ELEMENTS AND THEIR COMPOUNDS
INCLUDING
THE RARE EARTHS AT VERY LOW TEMPERATURES
WITH
PARTICULAR EMPHASIS UPON SUPERCONDUCTIVITY

By

W. T. Ziegler

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NAVY DEPARTMENT, OFFICE OF NAVAL RESEARCH
CONTRACT NO. N6-ori-192, TASK ORDER I
NR 016-1,06

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February 1, 1954 to May 1, 1954

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This Report Contains 3 Pages

I. SUMMARY

During the three-month period covered by this report, three platinum resistance thermometers for use with the adiabatic-shield calorimeter previously described have been calibrated over the range 10° to 80° K. This completes the calibration of these thermometers over the range 10° to 320° K.

The repair of the hydrogen liquefier, damaged by a minor explosion, is proceeding satisfactorily and will be completed shortly.

The relation of the thesis work of several graduate students to project facilities and program is discussed.

II. LOW-TEMPERATURE RESEARCH

The immediate objective of the present research is the determination of the heat capacities of several rare earth oxides (notably La_2O_3 , Nd_2O_3 and Pr_2O_3) over the temperature range 15° to 320° K. This objective has required the construction of an adiabatic calorimeter for the heat-capacity measurements and a cryostat for calibrating several platinum resistance thermometers against a standard thermometer calibrated at the National Bureau of Standards.

The adiabatic calorimeter is complete except for the final assembly of the gold-plated calorimeter can. Measurements with the calorimeter have awaited the completion of the calibration of a platinum thermometer for use with the calorimeter.

Four strain-force platinum resistance thermometers of the four-lead coiled-helix type, wound on mica cones have been constructed (See Status Report No. 31 dated August 1, 1953 to November 1, 1953). Three of these (the fourth proved defective) have now been compared experimentally at approximately ten-degree intervals over the range 10° to 320° K. in a special cryostat. The evaluation of the results and the preparation of resistance-versus-temperature relations for these thermometers is in progress.

In the course of the last set of calibration measurements using liquid hydrogen (2/25/54), the hydrogen liquefier suffered rather severe damage because of an explosion. This explosion apparently was caused by failure on the part of the operator to properly vent one of the liquid-nitrogen pots after shut-down. The liquid nitrogen trapped in the pot built up a high pressure and caused rupture of the pot. No one was hurt.

All parts necessary for the repair of the liquefier are now on hand and assembly will be completed shortly.

III. FUTURE WORK

Work during the past three months has been somewhat retarded because of rather heavy academic commitments on the part of the project director and because of study by Mr. McGee for his doctoral qualifying examination in Chemical Engineering. These commitments will be relieved by about June 1. It is expected that considerably faster progress will be made during the next six months (especially during the summer). Measurements of heat capacity of the oxides will be started, as well as work on the design and construction of the calorimeter for the range 2° to 20° K.

IV. WORK INDIRECTLY CONNECTED WITH THE PROJECT

Several graduate students are carrying out thesis problems more or less indirectly related to the work of the project. Mr. H. A. McGee, who is working for his Ph.D. in Chemical Engineering, will use the adiabatic calorimeter to measure the heat capacities of several organic compounds (α -pinene and β -pinene) over the range 15° to 520° K. In return, he has helped with the calibration of the platinum resistance thermometers and will assist with the heat capacity measurements on the rare earth oxides.

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Mr. W. M. Ligon who is working for his M.S. degree in Chemical Engineering is measuring the high-temperature heat capacities of CeO_2 and Sm_2O_3 over the range 30° to $1,000^\circ$ C. Measurements on these substances down to $15^\circ K$ are planned as part of the project program.

Messrs. W. H. Wright and W. D. Bradbury, Jr., also working for their M.S. degree in Chemical Engineering, will make a study of the feasibility of using the thermometer-comparator cryostat (in its present form) for the measurement of the thermal conductivity of metals over the range 70° to 300° K.

V. PERSONNEL

The following individuals have associated with the project during the period covered by this report.

| <u>Name</u> | <u>Position</u> | <u>Time</u> |
|-------------------------|--------------------|-------------|
| Dr. W. T. Ziegler | Director | Part time |
| Mr. H. A. McGee, Jr. | Graduate Assistant | Part time |
| Mr. W. M. Ligon | Graduate Assistant | Part time |
| Mr. W. D. Bradbury, Jr. | Graduate Assistant | Part time |

Respectfully submitted:

W. T. Ziegler
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Approved:

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