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SEMI-ANNUAL STATUS REPORT ON NASA GRANT NsG-533

1. Name of Investigator: Dr. Atam P. Arya

2. Title of Research: Investigation of the Decay Schemes of I^{129} and Sb^{125}.

3. If Completed, When: August 1, 1965

4. Progress to Date: With the help of gamma-gamma directional correlations spin assignments to be exited of I^{129} have been found to be $\frac{7}{2}, \frac{5}{2}, \frac{5}{2}, \frac{3}{2}, \frac{3}{2}$, and $\frac{5}{2}$ for the ground state, 27 kev state, 277 kev state, 482 kev state, 550 kev state and 1112 kev state respectively. In Sb^{125}, the levels at this ground state, 1075 kev, 1985 and 2230 kev has been assigned spins of $\frac{7}{2}, \frac{7}{2}, \frac{7}{2}$, and $\frac{9}{2}$ respectively. The multipolarities of the gamma rays in I^{129} have been calculated while the calculations for the multipolarities of the gamma rays in Sb^{125} are underway.

5. Number of Graduate Assistants used: One

6. Publications Resulting from this Project:

a. I^{129}. Submitted for publication - The American Physical Society and was also presented at the American Physical Society Meeting at New York in June 1965.

b. Sb^{125}. Under preparation for publication

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1. Name of the Investigator: Professor H. V. Fairbanks

2. Title of Research: Production of Dispersion Alloys with the Aid of Ultrasonics.

3. If Completed, When: Incomplete.

4. Progress to Date:

a. Thesis by Junior Hamilton Landes, II entitled "Dispersion of Inerts in a Molten Matrix by Ultrasonic Energy".

b. Thesis in progress by Won Kak Lee entitled "Ultrasonic Treatment of Alloys to Produce Dispersion Strengthening". Copy of Abstract follows as page 3 and 4.

5. Number of Graduate Assistants used: Two

6. Publications Resulting from this Project: No publications or lectures other than completed thesis mentioned above.

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1. Name of Investigator: Professor James H. McElhaney

2. Title of Research: Strain Rate Sensitivity of Various Biological Materials.

3. If Completed, When: February, 1965

4. Progress to Date: This was reported in detail in a 99 page report submitted in the last semi-annual status report.

5. Number of Graduate Assistants used: One

6. Publications Resulting from this Project:

a. "Mechanical Properties of Bone", presented at the Second Annual Engineering in Medicine Conference at Andover, New Hampshire, August, 1964.

b. "Dynamic Response of Bone and Muscle Tissue", submitted to the Journal of Applied Physiology.

c. "Dynamic Response of Some Biological Materials", to be presented at the winter meeting of the American Society of Mechanical Engineering, December 1965, in Chicago.

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ULTRASONIC TREATMENT OF ALLOYS TO PRODUCE DISPERSION STRENGTHENING

ABSTRACT

N66-10886

The purpose of this research was to evaluate the effect of ultrasonic energy in producing a dispersed phase during the metallurgical processing of alloys. Three systems which were investigated included: the effect of insonation during the solidification of cast iron on the distribution of graphite and pearlite formation, the effect of insonation on the decomposition of iron carbide in white case iron during heat treatment, and the dispersion strengthening of aluminum alloys.

Ultrasonic vibrations were introduced into the alloys by means of a high purity nickel rod attached to the transducer which operated at a frequency of 20,000 cycles per second with a maximum sonic output of 75 watts.

Insonation during solidification of gray cast iron produced more ferrite, less pearlite and more nodular graphite particles when compared with a non-insonated reference specimen. Author

Insonation during heat treatment of white cast iron produced splindle-type of ferrite grains, retarded the pearlite formation, gave slightly higher hardness, and increased the number of nodule graphite particles when compared with reference specimens which were not insonated but were heated at same temperature and duration of time. Insonation of specimens also retarded the rate of corrosion and decarburization during heat treatment.

Aluminum alloys 17^S and 24^S were insonated during the annealing

heat treatment, solution heat treatment, and precipitation heat treatment. It was found that the insonated aluminum 24^S specimens during solution heat treatment did not crack when subsequently cold worked as did the non-insonated reference specimens. It was also noted that insonation of aluminum during precipitation treatment reached the maximum hardness in a shorter period of time than did the non-insonated reference specimens.

Statistical analysis showed an interaction between ultrasonic intensity and temperature upon the resulting strengthening of the aluminum alloys.

It was also found that transmission of ultrasonic energy in metal rods decreased rapidly at temperatures above 1200°F. The metals tested included: aluminum, nickel, and three carbon steel rods.

1. Name of Investigator: Dr. Nathan Ness

2. Title of Research: Dissociation Effects on Spherical Bursts.

3. If Completed, When: Incomplete.

4. Progress to Date: The equations defining the position of the shock wave and the fluid properties between an expanding spherical piston and the spherical shock have been derived and are being programmed on the IBM 7040. Included in the analysis is the dissociation of oxygen molecules. This is a pilot investigation to determine the complications (if any) that may be introduced by incorporating chemical reactions and multi-component species into the one-component, non-chemically reacting analysis of Taylor (Taylor, G. I.: The Air Wave Surrounding an Expanding Sphere. Proc. Roy. Soc., London, A186, 273, 1946).

It has been found, for a piston expanding with constant velocity, that the problem remains self-similar provided the flow is in chemical equilibrium or frozen. Incorporating non-equilibrium chemical kinetics into the problem destroys similarity.

5. Number of Graduate Assistants used: Two

6. Publications Resulting from this Project: None

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1. Name of Investigator: Professor Armine D. Paul

2. Title of Research: Reaction of Sn(II) and Sn(IV) in Aqueous Solution.

3. If Completed: When: August 31, 1965

4. Progress to Date: The system under investigation proved to be more complex than originally anticipated and thus not all the

experiments outlined in the original proposal could be completed within the time limit.

5. Number of Graduate Assistants: One

6. Publications Resulting from this Project: None

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1. Name of Investigator: Professor Robert D. Snyder

2. Title of Research: Investigation of the Constitutive Equations for Multiphase Hypoelastic Materials.

3. If Completed, When: September 1, 1965

4. Progress to Date: The object of this project was to develop the effective constitutive equations for a macroscopically homogeneous multi-phase hypoelastic material. The work on this contract has been completed and a final report is in preparation and should be completed shortly. In addition to this completed work, several other projects have been initiated as a direct result of this contract. One of these involves an investigation of the thermodynamic aspects of the hypoelastic and linear preferred constitutive equations and should yield some very fruitful results. Also, an extensive experimental program is being developed for work on various materials with important space applications.

5. Number of Graduate Assistants: Two

6. Publications Resulting from this Project: None

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1. Name of Investigator: Professor Robert D. Snyder

2. Title of Research: Development of Constitutive Equations for Nuclear Grade Graphite for Space Applications.

3. If Completed, When: September 1, 1965

4. Progress to Date: The objective of this research was to obtain useful constitutive equations for the mechanical behavior of high grade nuclear graphite for effective use of graphite as a structural material in space vehicles.

All of the necessary preliminary work has been completed. The progress to date has been encouraging. The graphite material has been obtained and the test specimens have been cut and machined. Experimental techniques have been developed and the data processing methods have been set up. Much of the actual experimental data taking should be underway in the next few weeks.

Also during this period an extensive analytical study has been made of the temperature and rate dependent viscoelastic properties of nuclear grade graphite. Plans are now being made to extend the scope of this investigation to include high temperature as well as room temperature investigation of the mechanical properties of graphite.

To date, no student has been financially employed on this contract although two students are doing theses on problems closely associated with this investigation.

As a direct result of the work done on this contract to date, an extensive research proposal is in preparation for submission to NASA. This proposal should be completed within the next few months.

5. Number of Graduate Assistants: None

6. Publications Resulting from this Project: None

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1. Name of Investigator: Dr. William E. Vehse

2. Title of Research: The Paramagnetic Susceptibility of Lithium and Sodium Metal.

3. If Completed, When: Incomplete.

4. Progress to Date:

a. The conduction electron susceptivity of metallic lithium has been remeasured although we are still striving to improve the precision of these measurements. This work will be reported at the Chicago meeting of the APS in October.

b. The possibility of preparing alkali metal alloys has been considered in detail. Some samples have been prepared and electron usonances with unusual properties have been observed. This work will continue to be vigorously pursued.

c. Low temperature equipment has been purchased.

5. Number of Graduate Assistants used: One

6. Publications Resulting from this Project: None

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1. Name of Investigator: Professor Richard E. Walters

2. Title of Research: An Experimental Study of Viscous-Flow Nose-Shape Effects on Impact Tubes

3. If Completed, When: July, 1965

4. Progress to Date: Data reduction is complete and analysis is underway. The final project report in the form of a graduate thesis is being prepared. When this report is finished, a paper giving the project results will be submitted for publication to "The Physics of Fluids". Completion of the report and paper preparation is expected by December 1965.

Technical Results: The results of the project show a comparison of Reynolds number effects for different shape impact tubes. This is the first direct comparison available of such data. Analysis will result in a better understanding of viscous effects on these different shaped tubes which will be useful for impact tube design purposes.

5. Number of Graduate Assistants used: One

6. Publications Resulting from this Project: None

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1. Name of Investigator: Professor Richard E. Walters

2. Title of Research: Shock Tube usage as a Low-Cost Wind Tunnel.

3. If Completed, When: Incomplete.

4. Progress to Date: All test apparatus has been designed, and construction of project apparatus is nearing completion. Preliminary checkout of equipment has begun. An extensive literature survey has been completed which has resulted in the acquisition of over 100 reports and technical papers related to this project. Test programs have been completely planned and should commence in December of 1965.

Technical Results: Detailed analysis and information from the literature survey has shown many specific areas for test work. For instance, drag tests at high Reynolds numbers will be performed that will extend the range of available wind tunnel data.

5. Number of Graduate Assistants used: None

6. Publications Resulting from this Project: None.

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1. Name of Investigator: Dr. Daniel T. Watts

2. Title of Research: Cardiovascular, Respiratory, and Autonomic Nervous System Responses to Acute Hypoxia.

3. If Completed, When: Incomplete.

4. Progress to Date: In addition to the work undertaken by Dr. T. D. Darby and Mr. S. H. Davis, Mr. George Ford, a graduate assistant in Pharmacology, is now using labeled noradrenaline to do further studies on the role of the autonomic nervous system in regulating blood pressure. This work is considered important, not only from the standpoint of the research project, but it is the first time we have used isotopes in the Department of Pharmacology; and a number of individuals will benefit by the introduction of this important research.

5. Number of Graduate Assistants used: Two

6. Publications Resulting from this Project: Davis, S. H. "The Effect of Droperidol and Fentanyl on Cardiovascular Function in the Dog". Master of Science Thesis, West Virginia University, 1965.

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1. Name of Investigator: Professor James N. Shafer

2. Title of Research: The Effect of Sensory Deprivation on Social Dominance in the Domestic Cat.

3. If Completed, When: June 1, 1965

4. Progress to Date: The effect of sensory deprivation on the dominance behavior of domestic cats was investigated in two separate experiments involving widely desperate test situations. The two test situations were (1) food competitive behavior and (2) shock avoidance.

Experiment #1 - Effect of sensory deprivation on food competitive dominance behavior.

Subjects were eight domestic cats selected from a colony of animals maintained by the Psychology Department.

Dominance was determined by the number of pieces of liver obtained by each S. The S obtaining the greatest number of pieces of food was ranked first in the hierarchy, the S obtaining the second greatest number was ranked second, etc.

Experiment #2 - Effect of sensory deprivation on shock avoidance dominance behavior.

The subjects were seven domestic cats selected from a colony of animals maintained by the Psychology Department.

Each animal was conditioned to avoid the shock by responding to the light and buzzer which preceded the onset of the shock by 5 sec. Each animal was tested 25 trials a day until they reached the criterion of seven successful avoidance responses in any 10 trials. When all animals had reached this criterion they were given 100 additional trials to assure proficient performance for all animals. Following the training period the animals were placed in pairs in the shock compartment and the CS followed 3 sec. later by the UCS was presented. All possible paired comparisons of the seven Ss were tested for five trials per pairing for a series of three paired comparisons. The animal on the perch, which was large enough for only one animal, at the end of the 3 sec. period of shock was considered the dominant animal. Following the pre-isolation dominance tests all subjects were placed in isolation for 21 days. On the seventh, fourteenth and twenty-first days the Ss were removed from isolation and again tested in the shock compartment by the method of paired comparisons.

5. Number of Graduate Assistants used: None

6. Publications Resulting from this Project: None.

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1. Name of Investigator: Dr. Jerome F. Parmer and Mr. W. D. Teter

2. Title of Research: Preliminary Research on Goneometric and Cryogenic Radiation Properties; and the Mathematical Analysis of Louver Thermal Control for Spacecraft.

3. If Completed, When: Incomplete.

4. Progress to Date: The purpose of this report is to describe the results of the study made on methods for the determination of the thermal properties, absorptivity (α) and emissivity (ϵ), of materials at low temperatures. From the results of this study a method was devised which eliminates some of the deficiencies found in thermal or calorimetric methods presently used.

An intensive literature search into the different methods of determining absorptivity and emissivity revealed that there are several methods available which can be generally classified as either optical or thermal. There is a thermal or calorimetric method which contains features that have not yet been attempted.

The experimental procedure is divided into three parts. Part I entails the exposure of a sample material to radiation from a monochromatic source through one of the aperatures in the chamber. The system is allowed to reach equilibrium temperature and this temperature is measured. The irradiation is increased to twice its original value and a second equilibrium temperature is measured.

Part II of the experimental procedure requires removal of the sample from the chamber so that one surface of the sample may be coated in order to make the specimen black on one side. The procedure of part I is repeated.

Part III of the experiment involves the alternate exposure of first one side, the other side, and then both sides of the specimen to radiation through the aperatures located at either end of the chamber.

Part I of this experiment has been performed by others with similar experimental equipment; however, part II and part III present distinct advantages not found in other calorimetric methods.

The major problems that must be overcome in order to carry out this experiment are the chamber design and the measurement of the low (cryogenic) temperatures expected.

5. Number of Graduate Assistants used: One

6. Publications Resulting from this Project: None

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