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Chief
Defense Atomic Support Agency
Washington, D.C. 20301

Attention: Major M. E. Barnes, Project Officer
Blast and Shock Division

Subject: Progress Report No. 42, SRI Project GSU-3713
Contract No. DA-49-146-XZ-096

Progress Report No. 11, SRI Project GSU-4832
Contract No. DA-49-146-XZ-280

Covering the Period February 1 through February 28, 1965

Title: Pressure Transducer for Measuring Shock Wave Profiles
Phase X: Measurement of Low-Pressure Shock Wave Profiles

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I INTRODUCTION

In accordance with procedures outlined in Progress Report No. 32, Section A of the Current Status portion of this report applies to Contract DA-49-146-XZ-280 and the remaining sections apply to Contract DA-49-XZ-096.

II CURRENT STATUS

A. Granite Gages

Subsequent tests on cylindrical granite gages[1] have shown that the 0.050 inch radial tolerance between the 1.4 inch diameter gage cylinder and the 1.5 inch diameter mounting hole in the granite column is prohibitively large. When this volume is filled with C-7 epoxy, as originally planned, the 1.4 inch diameter gage cylinder acts as an unsupported column with the result that relief waves originating at its circumference decrease the pressure in the column more rapidly than the impinging pressure. Consequently, the gage, mounted in the column and extending to within 1/8 inch of the periphery, records a decay greater than that of the incident wave. Attempts to replace the epoxy with less compressible material such as aluminum have been unsuccessful; short duration recordings and distorted waveforms are observed. Since epoxy gages with thin (0.010 in.) brass shields have been successful,[2] the present results are attributed to a relatively large mass of material (aluminum) of shock characteristics dissimilar to granite and subsequent transverse distortions produced in the plane of the Manganin resistive element.

B. <u>Calcium Transducer</u>

As reported last month, calcium transducers have exhibited short shelf life because of chemical reaction of the calcium with gage materials. Attempts by various methods to place metallic leads directly in a Hi-D glass substrate without the use of filler materials or cements have had only limited success, with all of the methods lacking repeatability. In view of this, an alternate approach has been taken in which the calcium element has been deposited some distance from the lead tips, with connections to the leads being made by vacuum deposition of gold conducting paths on the substrate (Fig. 1). Separation of the lead tips and the calcium element should provide the required isolation between the calcium and the reactive filler materials used in placing the leads in the Hi-D glass substrate.

One calcium transducer employing this type of construction has shown no degradation at room temperature since construction (~ four days).

C. Equation of State of Hi-D Glass

The Hi-D glass wedge described in the previous Progress Report has been fired (Shot # 11, 080) yielding equation of state data in the range from 15 kbar to 40 kbar. These data overlap data from a previous wedge shot[3] (Shot # 8, 994); the agreement between the two is excellent. The data from both are presented in Table I.

III FUTURE WORK

A. Granite Gages

It is planned to construct and test cylindrical granite gages in which the radial tolerance is decreased to approximately 0.010 inch. Since this tolerance may prohibit construction of an inner electrostatic shield around the gage cylinder, it may be necessary to shield the mounting cylinder.

B. Calcium Transducer

Work during the final month of the low pressure program will be devoted to the peak pressure and pressure-time response of the calcium on Hi-D glass transducer.

REFERENCES

1. Williams, R. F. and P. H. Moravek, Stanford Research Institute Project GSU 4832, Progress Report No. 10, February 8, 1965.

2. Keough, D. D., "Pressure Transducer for Measuring Shock Wave Profiles," DASA 1414, Nov. 1, 1963.

3. Keough, D. D., Stanford Research Institute Project PGS 3713, Progress Report No. 22, pp 3-5, April 19, 1963.

Approved:

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TABLE I

LOW PRESSURE HI-D GLASS HUGONIOT DATA

Shot No.	Density (gm/cc)	Shock Velocity (mm/μsec)	Pressure (kbar)	Particle* Velocity (mm/μsec)
8994	6.20	3.40	45.0	0.213
			44.5	0.211
			42.6	0.202
			40.5	0.192
			40.1	0.190
			39.7	0.188
			39.3	0.186
			38.8	0.184
			38.0	0.182
			37.2	0.176
11080	6.20	3.42	40.3	0.190
			39.8	0.188
			38.8	0.183
			37.9	0.179
			37.5	0.177
			37.2	0.176
			36.3	0.172
			35.9	0.169
		3.41	34.3	0.162
		3.41	33.8	0.160
		3.40	32.2	0.153
		3.40	30.5	0.145
		3.39	29.8	0.142
		3.39	27.7	0.132
		3.37	25.2	0.120
		3.36	24.4	0.117
		3.36	23.1	0.111
		3.35	21.3	0.102
		3.34	20.7	0.100
		3.33	19.1	0.092
		3.32	17.8	0.086
		3.31	17.4	0.085
		3.30	16.8	0.082
		3.28	15.4	0.076

* One-half free-surface velocity.

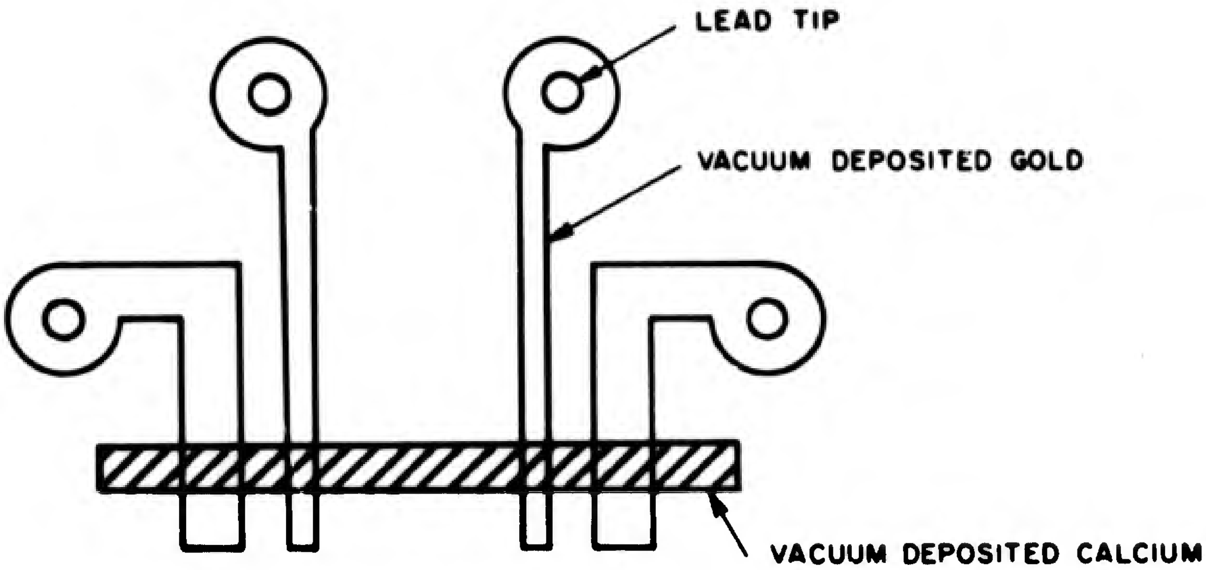

FIG. 1 PATTERN USED TO ISOLATE CALCIUM FROM LEAD TIPS