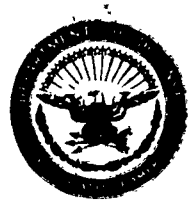

First Bi-Monthly Progress Report

A STUDY OF FUNDAMENTAL MECHANICAL PROPERTIES OF CERAMIC SINGLE CRYSTALS

Contract N600 (19)-59749

January 14 through March 14, 1963

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March 25, 1963

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Bureau of Naval Weapons
Department of the Navy
Washington 25, D. C

SUMMARY

Measurement of cross-bending strength and Young's modulus of pure silicon carbide has been carried out on approximately twenty-five samples at room temperature.

Construction of apparatus to extend strength and elasticity measurements to very thin (< 0.001 inch) crystals is complete.

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I. INTRODUCTION

This is the first bi-monthly report on research sponsored by the Bureau of Naval Weapons; under Contract N600 (19)-59749 and covers the period January 14 through March 14, 1963. This is a continuation of work previously conducted under Contract NOw-61-0676-c.

II. WORK PROGRESS

A. Apparatus

A more sensitive version of the cross-bending apparatus has been built. Its load detection limit is 0.01 grams, with a total load capacity of 200 grams. After it has been checked out, it will be used to measure strength and Young's modulus of thin crystals whose thickness ranges from less than 0.001 inches to 0.005 inches. The lower limit of the present apparatus is approximately 50 grams.

B. Strength

Cross-bending strength measurements have been made on 27 samples of pure silicon carbide. These data are shown graphically in Figure 1 as a plot of log M.O.R. (modulus of rupture) versus thickness. These data, still preliminary, suggest that strength is independent of thickness. Such is not the case for boron-doped silicon carbide in which the strength is inversely proportioned to the thickness[1].

An analysis of a sample of the silicon carbide crystals used in this recent study is shown in Table No. 1. Analytical data are being obtained for each of the boron-doped silicon carbide crystals studied earlier[1] to ascertain whether there is a relationship between strength and thickness which is dependent on the degree of boron doping.

C. Young's Modulus

Young's modulus values measured on the pure silicon carbide crystals varied from 47 to 65 x 10^6 psi, averaging 56.4 x 10^6 psi. Additional data are required to determine whether boron-doping has a significant effect on the elastic modulus of silicon carbide.

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(1) "Mechanical Properties of Silicon Carbide Single Crystals," H. D. Batha and D. P. H. Hasselman, Final Report. NOw-61-0676-c, Sept., 1962.

FIGURE 1

MODULUS OF RUPTURE
VS
THICKNESS

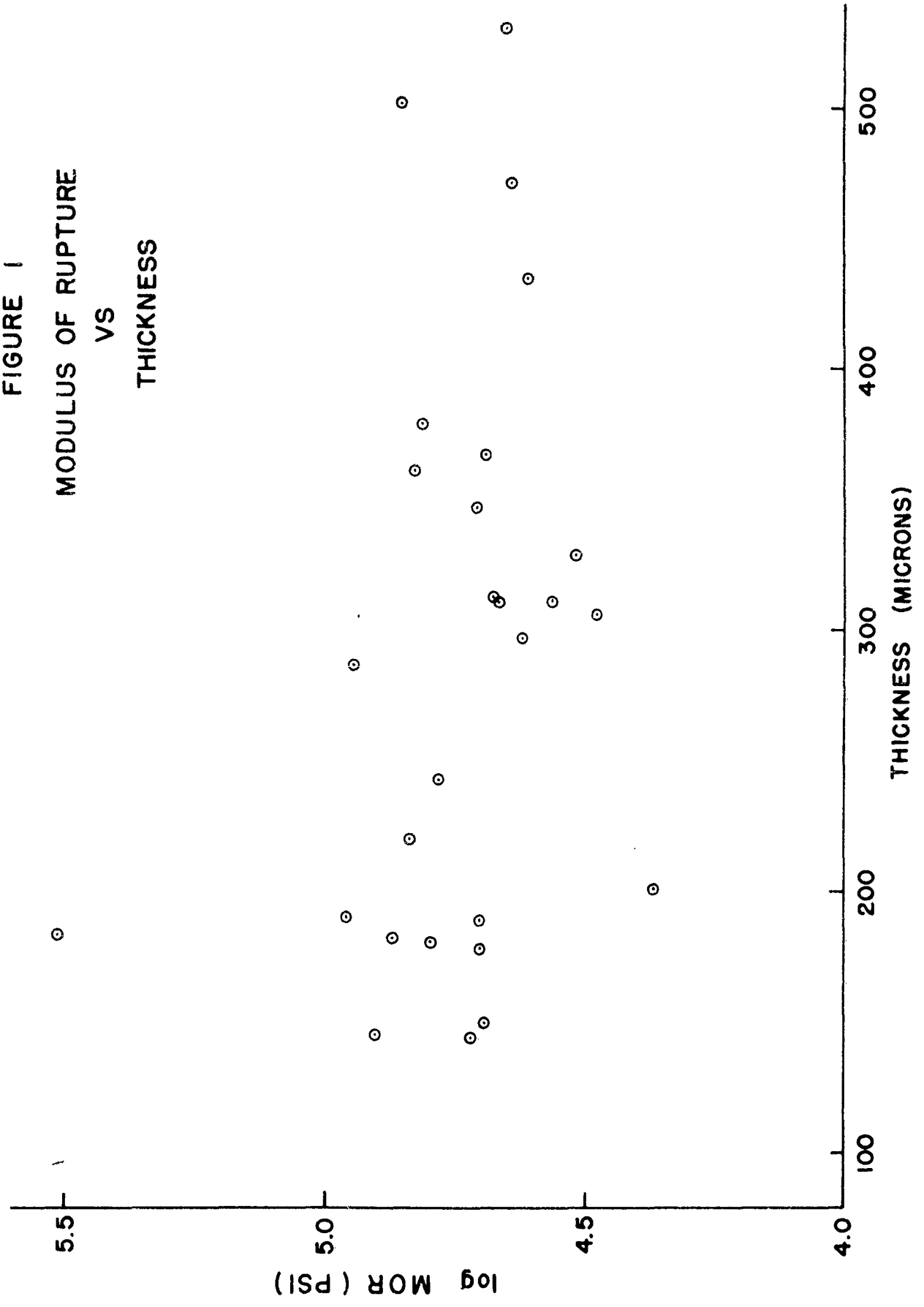

TABLE NO. I

Spectrographic Analysis of Pure Silicon Carbide Crystals (ppm)

B	< 20
Mn	< 10
Mg	< 10
Fe	< 10
Al	< 20
Ti	< 20
Ca	15
Cu	< 10
Zr	< 20
V, Ni	n.d.

III. FUTURE PLANS

Work during the next report period will be directed along the following lines:

1. The new apparatus will be checked out and calibrated.

2. Thin crystals ($< .005$ inches) of both pure and boron-doped silicon carbide will be studied.

3. Analysis of earlier samples will be completed.

4. Thick crystals will be ground and lapped on one side (the side loaded in compression) to provide more nearly parallel sample surfaces. Since the ground surface will be loaded in compression this should not alter the measured strengths but should improve the reproducibility of measurement.

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