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A Multiple-Crystal Holder for Ultrasonic Measurement

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A multiple-crystal holder for simultaneous ultrasonic measurement on several crystals is presented. Figures are included to show clearly how it is assembled and how each component works.

In ultrasonic measurement one usually measures a single mode velocity in one crystal as a function of pressure and/or temperature, then removes the crystal from the holder which is inside a pressure vessel or temperature control unit, changes specimen or changes modes (e.g., from longitudinal to shear mode) by changing transducers, and then repeats the experiment.[1] It is thus very time consuming. Moreover, when a measurement is made at a pressure P (or temperature T), the pressure (or temperature) is not exactly identical to that obtained on the other crystals or modes. It is therefore necessary to analyze each run and interpolate at a specific temperature or pressure for all crystals or modes. Hence, it is desirable to have a holder which can hold several crystals so that all the necessary measurements (and possibly redundant measurements) can be carried out on all the crystals at the same T and P conditions. This paper describes a simple four-crystal holder which can be easily constructed for measurements on cubic crystals. This could readily be extended to six or so crystals for studying hexagonal, tetragonal, and trigonal systems.

The schematic arrangement is shown in Fig. 1, which reveals the cross-sectional view. The holder consists of (1) a cylindrical shell made of brass partially open on two sides to make handling and alignment of the specimen easy; (2) an Amphenol socket; (3) four identical electrode complexes (A,B,C,D) each of which on one side (top) houses the specimen base and provides an electrode on the bottom side; (4) the holder base (E) which is simply half of A, namely, the top half of A; and (5) a small thermocouple (or diode) in A to monitor the temperature. In between each complex is the specimen chamber where the specimen with the transducer bonded on top of it can be manipulated by pushing against the specimen base, which is supported by three identical base springs. The total stress exerted on the specimen by the base springs

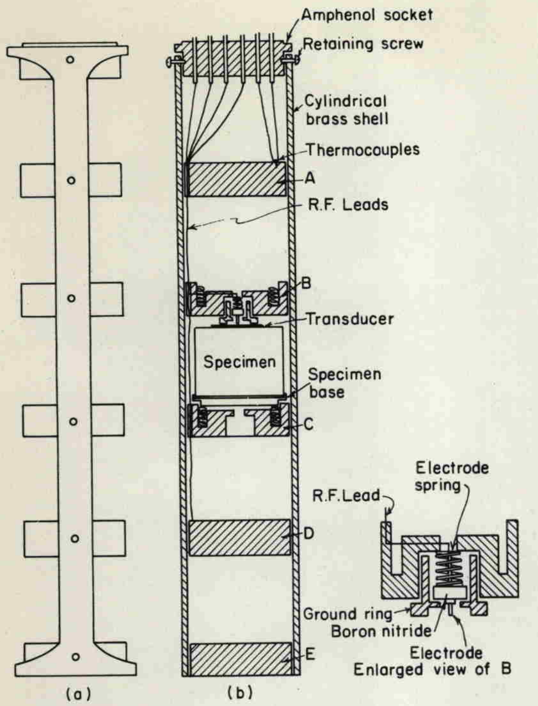

FIG. 1. (a) Side view of holder. (b) Cross-sectional view of four-crystal holder (only B and part of C are shown in detail).

is less than 0.05 bars (0.7 psi) so that no damage results to the specimen.

The electrode is connected through an insulating material (high purity boron nitride). The electrode lead is shielded inside the electrode complex and is led through the lead slot of the complex up to the pin on the Amphenol socket. This socket is matched to the feedthrough connected to a Bridgman seal, and the lead is eventually led out of the pressure vessel (or through a feedthrough in a temperature box). The electrode is pushed against the transducer by an electrode spring carefully chosen to give a good contact, yet not exert too much stress on the transducer. The ground ring sits on top of the outer ring of the transducer. The diameter of this ring has to match the size of the transducer. Figure 2 shows the top view and the bottom view of B where the relative configuration of the electrode and the ground ring is clear.

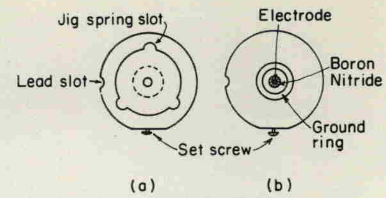

FIG. 2. (a) Top view of electrode complex (B in Fig. 1). (b) Bottom view of electrode complex (B in Fig. 1).

Specimens of varying stiffness, ranging from sodium to silicon, have been studied from 4 to 350 K, up to 10 kilobars at 5 to 40 kHz. The performance is excellent.

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[1] K. M. Koliwad, P. B. Ghate, and A. L. Ruoff, Phys. Status Solidi 21, 507 (1967).