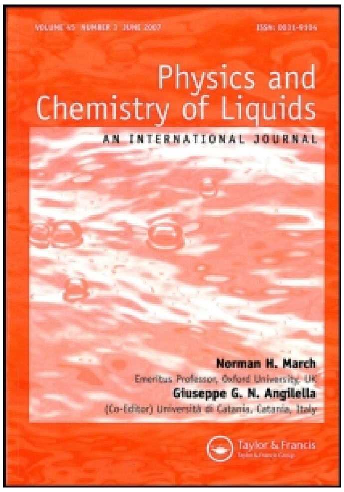

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The velocity of sound in liquid cesium from its melting point to 655°k

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The Velocity of Sound in Liquid Cesium from its Melting Point to 655 °K

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Abstract—The velocity of sound in liquid cesium has been measured from its melting point to 655 °K, with an accuracy of 1.5%. The velocity of sound was found to be linear with respect to temperature and is described by the relation: $V = 1050\text{–}0.2882T$ meters/second. Comparison is made with some recently published data.

The velocity of sound in liquid cesium has been measured for comparison with the recent measurements of Novikov *et al.*[1] and Kim *et al.*[2] The measurements cover a temperature range from the melting point to 655 °K, compared with the range from the melting point to 1100 °K of Novikov *et al.* and from the melting point to 520 °K of Kim *et al.* The measurements agree to about 1.5% with those reported by Novikov *et al.*, and also agree to 0.5% with the melting point value reported by Kleppa.[3]

The velocities were measured using a reflection technique[4] in which the buffer rod was fused quartz, and the transducer was mounted on the top of the buffer rod. The accuracy of this technique was established by measuring the sound speed of distilled mercury at room temperature. (To overcome the surface tension of mercury, a drop of kerosene was placed on the end of the buffer rod in contact with the mercury.) The measured values of the sound speed of mercury agreed within 0.7% with the published value of 1460 m/sec.

In the cesium experiment, the 99.999% pure cesium used was obtained from Materials Research Corporation. An atmosphere of argon was maintained in the vacuum chamber where the experiments were performed, and a furnace wound with Kanthal wire was used for the experiments. The resulting temperatures, measured using a potentiometer in conjunction with Chromel Alumel thermocouples, were stable to $\pm 1°$, with an uncertainty of 0.5°.

The experimental velocities of sound in liquid cesium are tabulated in Table 1 and plotted in Fig. 1. The straightline function shown, which follows the relation $1050 - 0.2882T$, was computed from a least squares fit of the experimental data, with the uncertainty being 1.5%. The adiabatic compressibilities tabulated in Table 1 and plotted in Fig. 2 were calculated using the experimental density values of Bonilla.[5]

TABLE 1 Experimental Velocity of Sound in Liquid Cesium and Calculated Adiabatic Compressibilities

T(°K)	V(m/sec)	d† (g/cm^3)	B_s(cm^2/dyne)
337.5	972.7	1.795	58.88×10^{-12}
338.0	959.0	1.794	60.61
339.0	945.0	1.793	62.45
423.5	918.6	1.755	67.49
427.0	931.7	1.755	65.64
427.0	916.6	1.755	67.82
428.5	913.8	1.753	68.32
438.0	927.0	1.750	66.50
441.0	931.2	1.749	65.94
441.0	913.5	1.749	68.52
549.5	894.5	1.700	73.48
553.0	876.1	1.699	76.68
557.0	889.2	1.698	74.48
557.0	887.1	1.698	74.84
557.0	888.3	1.698	74.63
607.0	882.9	1.681	76.31
608.5	867.4	1.678	79.21
610.5	875.5	1.674	77.94
655.0	878.2	1.652	78.49

† Ref. 5.

The temperature dependence of the velocities of sound in most liquid metals is not well known beyond the melting point; thus, a linear temperature coefficient of the velocity is usually assumed. The experimentally measured velocities of sound in liquid cesium show no abnormal temperature effects, with no anomaly of the type observed in liquid aluminum.[4] In liquid aluminum, an anomaly of 2.5% was observed between 1550 and 1767 °K, about midway between the melting and boiling points. Novikov *et al.* covered a range extending all the way to the boiling point of liquid cesium and

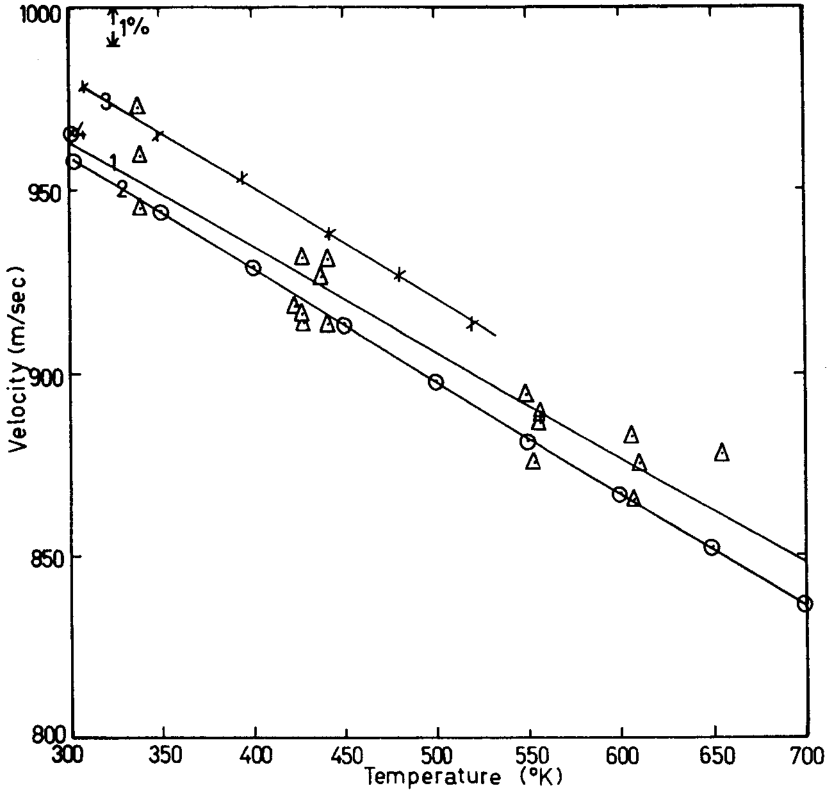

Figure 1. Plot of velocity of sound in liquid cesium vs. temperature. 1. △ present work; 2. ⊙ Novikov *et al.*; 3. × Kim *et al.*; 4. ⊗ Kleppa.

their measurements show no anomaly. It would be of interest to see whether velocities of sound in other liquid metals show anomalies of the type observed in liquid aluminum.

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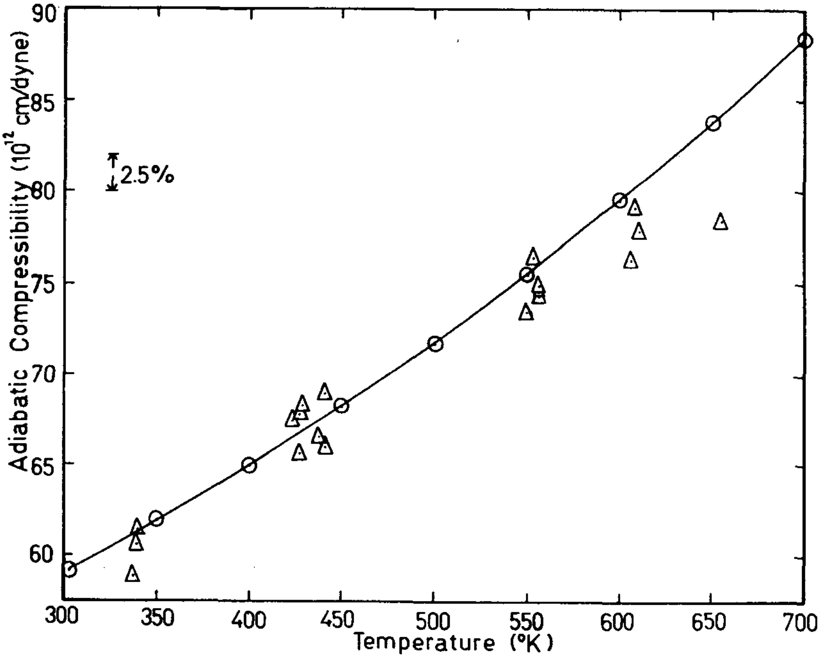

Figure 2. Plot of isothermal and adiabatic compressibility of liquid cesium vs. temperature. △ present work; ○ Novikov *et al.*

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