(since this line was not found in experiments with other separated isotopes of Se).

Running through the other possible reactions on Se^{78} (n2n, n2p, nα, npn), one finds that the isomers of products of such reactions have been well investigated and that no isomer has been found which has the observed state (T = 5 to 6 min, E = 500 kev). We can therefore assume that As^{78} has a metastable state with an energy of 500 kev.

A possible decay scheme for As^{78} is shown in the figure.

In conclusion, the authors thank A. N. Protopopov and his colleagues for neutron irradiation of the samples.

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LOW TEMPERATURE POLYMORPHISM OF METALS

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THE existence of a so-called low-temperature modification of tin (α-Sn), stable below 18°C, is well known. Spontaneous transformation of white tin into gray, however, does not occur in practice even upon substantial holding times at low temperatures. It can be brought about by means of plastic deformation at temperatures below the transformation point.[1]

Works of recent years have established the existence of low-temperature allotropic transformations which proceed also in lithium and sodium[2,3] upon plastic deformation under conditions of strong supercooling. One can surmise that this phenomenon is characteristic of many non-close-packed metals. At the same time, on account of the small diffusion mobility of the atoms, there is practically no reorganization of the lattice into a new more dense structure stable at low temperatures. Plastic deformation facilitates the process, helping surmount the activation barrier.

In contrast to the preceding investigations, we used in the present work a method of mechanical tests, which consisted of studying the compression diagrams of specimens of lithium, sodium, cesium, bismuth, and beryllium with subsequent warming and registration of the volume changes during the reverse transformation. The bismuth and beryllium were monocrystals of 99.98% purity; the lithium, sodium, and cesium were chemically-pure polycrystals. The tests were run on a one-ton machine with a stiff dynamometer, adapted for measurements at helium temperatures.[4,5] The rate of deformation was constant at 0.03 mm/sec. The deformation and warming curves were recorded on photographic film.

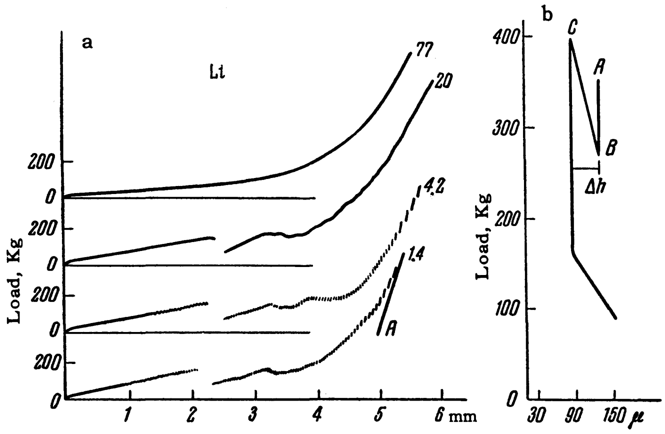

FIG. 1. a – Machine compression diagrams for specimens of chemically pure lithium at temperatures from 77 to 1.4°K; b – Dilatometric curve taken during warming of the lithium specimen deformed at a temperature of 1.4°K.

A typical deformation diagram in "load vs. absolute compression" coordinates is shown in Fig. 1a for lithium (the polymorphic transformation of which has been well studied by x-rays[2,3]). At 77°K it is a smooth curve with a hardening shape at high degrees of reduction, without any singular points indicative of the occurrence of a transformation. It should be noted here, however, that x-ray investigations under these conditions recorded a partial transformation from body-centered cubic modification to face-centered. On reducing the deformation temperature to 20°K and lower (down to 1.4°K), a characteristic disruption appears on the curve with a sharp drop in resistance to deformation, in response to allotropic transformation in a considerable portion of the volume of the deformed metal.*

The most direct demonstration of a polymorphic transformation in our experiments is the occurrence of volume changes during the reverse transition in the course of warming the deformed specimen (Fig. 1b). After deformation, the specimen was unloaded to a stress corresponding to the point A on the curve (temperature 1.4°K) and then it was warmed. At first, with increase in temperature, the load falls on account of the thermal behavior of the testing machine (branch AB). This circumstance was verified by separate experiments without specimens. On reaching the point B (corresponding to a temperature of 143°K) the load begins to increase sharply with a simultaneous growth in length of the specimen, which in a well defined manner can be related to the start of the reverse transformation. The temperature corresponding to the end of the transition (point C) is 167°K. On further increase of the temperature, the load again begins to fall. Thus, the size of the gap Δh represents the absolute extension of the specimen in the process of transformation and allows one to estimate a lower limit for the relative change in density during the transitions. For lithium $\Delta\rho/\rho$ amounts to about 15%. The size of Δh falls with increasing temperature of deformation indicating a decrease in completeness of the transition, and at 77°K is not registered by this method.

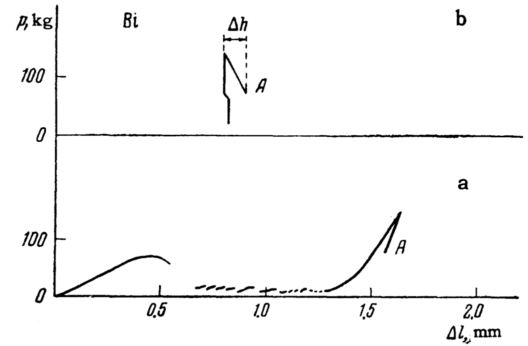

FIG. 2. a – Machine compression diagram for a bismuth specimen at a temperature of 77°K; b – Dilatometric curve taken during warming of a bismuth specimen deformed at 77°K.

Analogous curves were obtained for sodium. In this case, a clearly expressed allotropic transformation is observed only at temperatures of 4.2°K and below. The temperature for the start of the transformation during the reverse transition is 73°K and the value of $\Delta\rho/\rho$ is approximately 8%.

In cesium, no polymorphic transformation is recorded on the deformation diagram even at 1.4°K, although the shape of the warming curve allows one to come to a conclusion about the existence of a transition in an insignificant volume.

Such behavior of these three alkali metals must apparently be associated with the substantial decline of the characteristic temperature (474, 192 and 50°K for lithium, sodium, and cesium respectively) and permits us to surmise the presence of polymorphism in the entire group of alkali metals.

In Figs. 2a and b, a deformation diagram and warming curve are presented for bismuth deformed at 77°K. This diagram permits a definite conclusion to be drawn about the presence in this case of also a polymorphic transformation with a reorganization of the lattice in the direction of an increase in density with a transformation temperature ~ 80°K.

The phenomenon of disruption of the load on the compression diagram is also observed for beryllium at temperatures of 4.2°K and below.

Thus, a conclusion can be drawn about the widespread prevalence of low-temperature polymorphism which is observed in tin, sodium, lithium, cesium, bismuth and beryllium.†

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*An interesting feature of the deformation curves is the discontinuous character of the deformation at helium temperatures, noted by the authors in aluminum,[5] one of the possible causes of which is mechanical twinning.

†The possibility is not excluded that the superconductivity of bismuth and beryllium condensed on cold substrates[6] is connected with the low-temperature modifications of these metals.

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