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In recent years, investigation of the pressure scale above 30 kilobars has become an important field of research. Kennedy has redetermined a number of fixed transition points to 42 kilobars,[1] the highest being that of cesium, where the transition has been placed at 41 kilobars. Due to its high reactivity cesium is difficult to handle, and presents difficult loading problems. In the course of our study on the effect of pressure on the electrical resistance of the rare earth metals, we have determined a transition in ytterbium in the same region, and since this material is much simpler to handle, we believe that it could be used as a substitute for the more reactive cesium. The transition pressure that we find for ytterbium at room temperature is 40 ± 2 kilobars or 41 ± 2 kilobars based on a bismuth 6-8 transition at 88 and 91 kilobars respectively. Our early work led to the former value of the bismuth transition but our recent work indicates that the higher value is probably more correct.

The earliest work on ytterbium was done by Bridgman.[2] He investigated the pressure - volume phenomena to 39 kilobars, and the electrical resistivity to an uncorrected 98 kilobars. The volume work was not carried to sufficiently high pressure to determine the 40 kilobar transition. He did, however, find the maximum in the pressure vs resistance curve, but due to a combination of the sluggishness of the transition and the fact that his sample was under a relatively large pressure gradient, he did not conclude that a transition had occurred. More recently, Semerchan and Popova[3] identified this change as a transition and placed the pressure at 50 kilobars. This is certainly high, and is probably based on the incorrect value of 125 kilobars for the bismuth 6-8 transition.

The ytterbium we used was 99.9% pure and was obtained from Research Chemicals of Burbank, California.

The metal was extruded into wires 0.003 inches in diameter, annealed at 400°C and bent into a circular arc, the center coinciding with the axis of the anvils. The last procedure minimizes the pressure gradient in the system. The wire was mounted between silver chloride discs in 1/2 in. Bridgman anvils. The resistance of the sample was determined by measuring the EMF drop across the sample while a known fixed current was passed through the system.

A typical pressure resistance curve is shown in Fig. 1. The resistance changed by a factor of roughly 14 in going from the α to β phase. The transformation is quite slow, running well over an hour, however, if an overload of 5 to 10 kilobars is applied the transition occurs very rapidly. In spite of the sluggishness of the transition, there is no difficulty in locating the pressure at which the transition starts due to the change in sign of the pressure coefficient. There is a very large hysteresis in the pressure-resistance behavior on decompression. The β-α transition does not occur until a pressure of about 10 kilobars is reached, and indeed, it appears that it is not complete until the pressure has been completely removed.

The figure for the transition, 40 or 41 $\pm$ 2 kilobars is the result of 9 determinations. Dr. J. Slaughter[4] has found in the tetrahedral apparatus that the transition occurs at 42 kilobars, which is well within our error factor.

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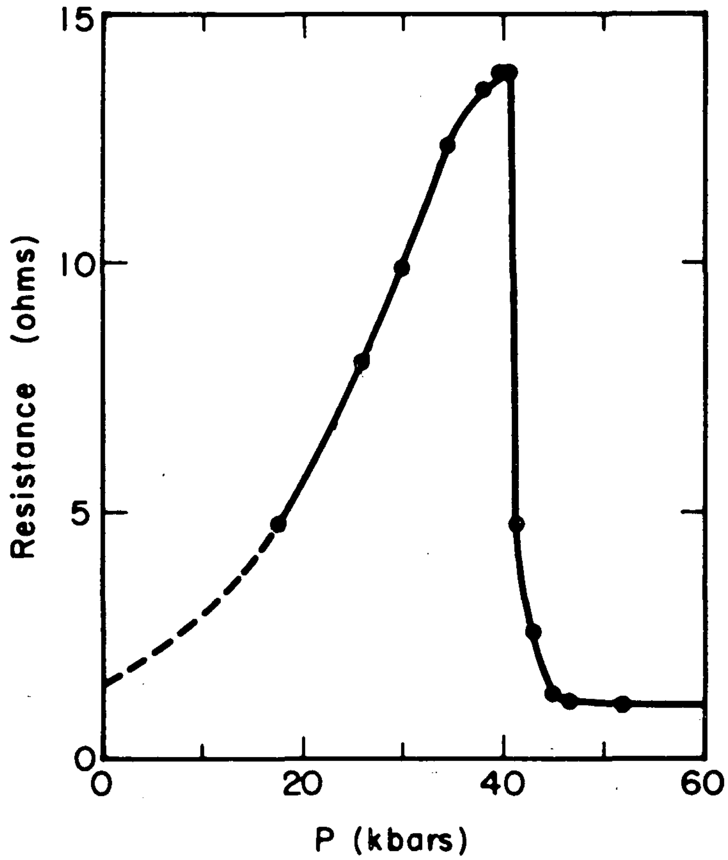
Fig. 1 - Pressure - Resistance Curve of Ytterbium



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