

observed that CuCl transforms to a birefringent phase that is opaque in transmitted white light.

The present experiments were motivated by the above results and their suggestion of the possibility of a highly-conducting high-pressure phase. Indeed, we have observed a sharp resistance drop in CuCl by a factor of $\sim 10^7$ at 40 kbar indicating the entering of a metallic phase before it transforms into a much less conducting phase at $P \gtrsim 55$ kbar.

2. Experimental details

Crystals were grown using the gel-growth process, (Armington and O'Connor 1967, 1968) because this process is capable of yielding large high-purity (Armington *et al* 1967) single crystals. The crystals were grown at 15°C to slow down the rate of growth and thus improve the purity and crystalline perfection (Henisch 1970). Powder pattern x ray analysis indicated that the crystals were single phase in the zinc blende structure. Clear tetrahedral crystals 1.0–2.5 mm on an edge were hand-picked for property measurement. Since the crystals tend to decompose to CuCl_2 and Cu on exposure to air (especially moist air), they were stored in a 1% HCl solution, a few Cu pellets being added to the solution to retard the $\text{Cu}^+ \rightarrow \text{Cu}^{2+}$ reaction. A dry N_2 atmosphere was used whenever the crystals were removed from the solution for handling. The crystals were always handled and grown under dim red light to avoid light-induced deterioration. Isomica packing rings and AgCl or Teflon pressure medium were used with the Bridgeman anvil sets to provide the high-pressure environment at room temperature. Both Mo- and W-strips with Cu-coated contacts to the samples were used for leads. Crystals were ground down to 0.1–0.2 mm thick triangular platelets and loaded on to the anvil sets. The two-point resistance was measured by an HP 410B VTVM, and the pressure was calculated from the load determined by a calibrated Dutt–Norton gauge. Runs on one polycrystalline sample

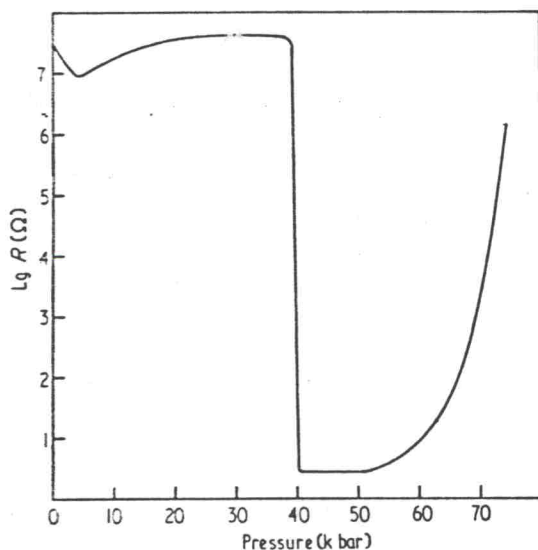


Figure 1. Schematic pressure dependence of resistance for a CuCl crystal at room temperature (300 K).

(prepared by melting and cooling at room temperature for $P \leq 20$ kbar).

Schematic results for one sample show resistance R decreased initially, then increased only slightly (peak at 40 kbar) with pressure up to 40 kbar. Below 40 kbar, $R \sim 30 \times 10^6 \Omega$ and $\sim 6 \times 10^6 \Omega$ through 40 kbar by ≤ 2 kbar. Further increase of pressure led to a sharp drop in resistance. However, for higher P , R increased again, ~ 75 kbar.

It should be noted that the sharp drop in resistance was caused by pinching or shearing in only seven of them. We observed defects in the samples. Six of the samples were single crystals. One semiclear crystal, with a sharp drop in resistance, occurred in crystals prepared by the same method. We also noticed that the resistance decreased and decreasing pressure cycle change (or latent heat) accompanied the transition. In the case of Sm-monochalcogenides, a similar transition over a 9 K range was also observed in one sample. As the pressure decreased, the resistance dropped rapidly without significant hysteresis. The anomaly is ab-

3. Conclusions

The results shown in figure 1 indicate a transition in CuCl at 40 kbar and a sharp drop in resistance at somewhat higher critical pressure required for the transition. These observations are consistent with the fact that CuCl powder at high pressure near 40 kbar can easily transform into CuCl particles and their resistance drops.

Only tentative speculation is possible at this time although the covalent- to metallic- to collapsed metallic phase transition is suggested.

Acknowledgments

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