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## LETTER TO THE EDITOR

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High pressure metallic phase in cuprous chloride single crystals

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Abstract. An insulator-metal-insulator sequence of transitions has been observed as a function of pressure in a freshly prepared single crystal of CuCl. The metallic phase is evidenced by a sudden drop in resistance by a factor of  $\sim 10^7$  between  $\sim 40$  Kbar and  $\sim 55$  Kbar.

## 1. Introduction

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Cuprous halides form tetrahedrally coordinated zinc blende structures and thus in some sense are related to the isoelectronic sequence of group IV elements, and III-V and III-VI semiconductors. However in many ways the cuprous halides are anomalous when compared to other members of the isolectronic sequence. Martin (1970) has shown that the reduced bulk modulus of CuCl is only  $\leq 20\%$  of that expected by extrapolation, and that the reduced shear moduli are also unexpectedly soft. Inelastic neutron scattering results (Carabatos *et al* 1971, Hennion *et al* 1972) show that the transverse acoustic branches are low and flat over most of the zone, and that there is an intermediate maximum in the longitudinal acoustic [110] branch of CuCl. Extensive optical, ultraviolet and x ray photoemission data (Tono *et al* 1973, Goldman *et al* 1974) give evidence that the 3d levels in Cu are strongly hybridized into the valence band as might be anticipated solely from the structural dissimilarity of the cuprous halides and the alkali metal halides. In CuCl the upper branch of the valence band arises mainly from the 3d states (Tono *et al* 1973, Goldman *et al* 1965).

Increase of pressure causes covalent and moderately ionic 4-coordinated zinc blende structures to collapse to the (4 + 2)-coordinated white tin structure. Highly ionic zinc blende structures on the other hand collapse directly to the insulating 6-coordinated NaCl structure (Klement and Jayaraman 1966). Again the cuprous halides are anomalous in that many phases, (Edwards and Drickamer 1961, Van Valkenburg 1964, Rapoport and Pistorius 1968, Bradley *et al* 1969) as yet not well characterized, have been observed by a number of workers as a function of pressure below the melting curve. Van Valkenburg has

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