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The cohesion of the metals of group IB

It appears to be generally agreed that the cohesion of group IB elements is much greater than would be expected for univalent metals: equally it is not clear as to why this should be so, as commentaries on the topic [1, 2] indicate. The basic difficulty lies in finding an acceptable postulate regarding an additional contribution to the cohesion from underlying electrons. In a recent paper [3], in which, *inter alia,* the constitution of some compounds of transition metals with B-group elements was discussed, it was hypothesized that a strong ionic contribution existed for example in the bonding of NiAl, and, by inference, in analogous compounds such as beta-brass CuZn; in effect, for the latter we may write $Cu^{2-}Zn^{2+}$, although the situation is better expressed in Fig. 1, which schematically shows ionic combination of zinc valency electrons into the d-shell of copper with simultaneous release of electrons from the copper. Now if this explanation is valid, there would seem to be no *prima facie* reason why the same type of process may not operate in metallic copper, as illustrated in Fig. 2. It is perhaps easier to picture the latter as a resonance or consecutive reaction (as drawn in Fig. 2, cf. Fig. 1 and [4]) because of the identity of atomic species, and this interpretation is probably consistent with the evidently lower mechanical strength in copper compared with beta-brass [5, 6] and with the 0.5 T_m type (i.e. a metallic type) of oxidation classification [7] for copper again contrasted with beta brass [8], although it may not be so satisfactory with respect to the transport properties. The hypothesis is attractive; however, further work will be necessary to establish if it is compatible with the broader sequence of changes in bond mechanisms as we proceed along the periods of the Table, and whether or not it may be extended to neighbouring groups VIIIC and IIB. A well-known text [9] touches upon many points of interest related to the present purpose, although the standpoint is essentially different.

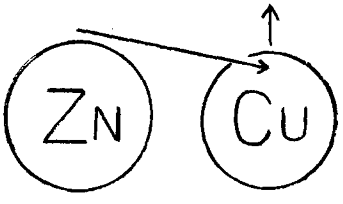

Figure 1.

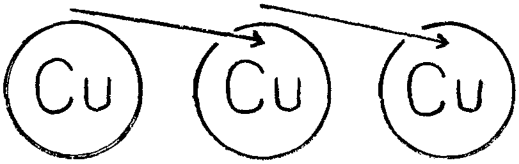

Figure 2.

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X-irradiation and the annealing behaviour of polyethylene

We would like to report the results of an experiment carried out to complement a more extensive study of the mechanisms of crystallite thickening during the annealing of solution-crystallized linear polyethylene (Rigidex 50) [1].

It is generally accepted that the X-ray dose received by a specimen during a typical diffraction exposure is insufficient to produce any evidence of damage in the form of gross structural changes such as a reduction in crystallinity. The principal mechanisms of energy absorption in the 10 kV range are photoelectric and Compton recoil, most of the structural effects being associated with molecular excitation and ionization by photo electrons. There is no evidence for a threshold dose below which no damage occurs [2], although the very small damage levels associated with low doses become difficult to detect. It must therefore be assumed that even the small doses and low dose rates associated with X-ray diffraction will produce some damage. In polyethylene for example such damage can be expected to take the form of a few isolated crosslinks.

We have considered the possibility that molecular mechanisms of chain sliding [3] and unlooping [4] already proposed to explain crystallite thickening might be sensitive to any scattered crosslinks introduced as a result of a diffraction exposure prior to annealing.

In an experiment designed to reveal any such effect the specimens of solution-crystallized polyethylene were irradiated for 8×10^4 sec in an uncollimated beam from a Mo X-ray tube operated at 30 kV 20 mA. The target–specimen distance was 14 cm, and the dose received by the specimen was estimated on the basis of some thermoluminescent dosimetry measurements to be in the region of 0.25 Mrad. This dose is between one and two orders of magnitude larger than that received by a specimen during a typical small angle diffraction exposure. The irradiated specimen was then annealed for 2 h alongside a standard and the

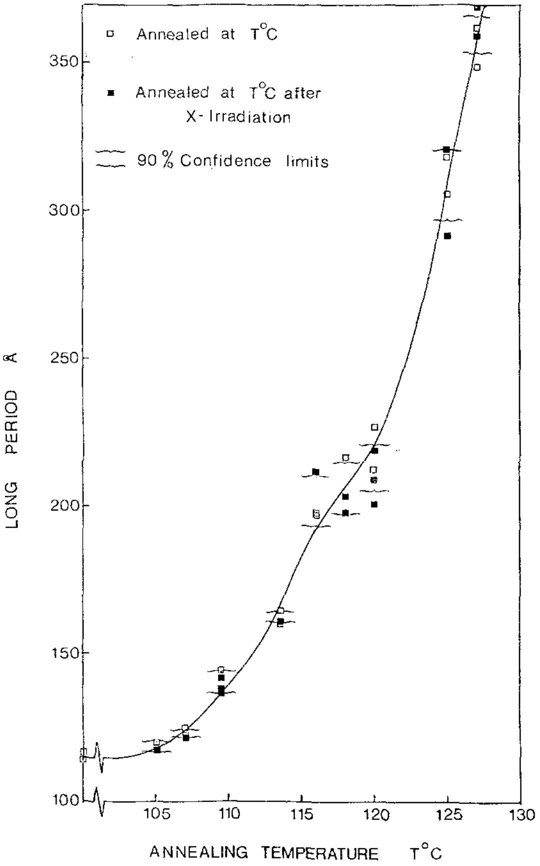

Figure 1 The effect of 2 h anneals on the long period of solution crystallized linear polyethylene specimens some of which had been previously exposed to X-rays.