unaffected by density-of-states effects at the higher magnetic fields. A detailed analysis of these effects is complicated by energy level broadening and the fact that, for the range of absorption constants involved ($\alpha \approx 20$ cm^{-1}), the absorption edge probably involves nonvertical transitions.[5]

The discrepancy between the experimental value for γ in the linear high-field region and the theoretical value for the simple model, may be due to a number of other effects: (1) Zeeman splitting of the valence band which is believed to be either p-like or d-like in character. (2) Second-order interactions between the various branches of the valence and conduction bands which may produce displacements of the top of the valence band and the bottom of the conduction band relative to one another[6] and which may result in a modification of the energy surfaces in the presence of a magnetic field.[7] (3) Spin-orbit interaction effects in the conduction band which may produce displacements in the lower magnetic levels so that they do not occur at positions predicted by the simple model.[8]

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Structure Sensitivity of Cu Diffusion in Ge

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We have observed a striking dependence of the diffusion of Cu in Ge upon the structural perfection of the Ge. Electrical-conductivity and radio-tracer (Cu^{64}) studies have been made on Ge samples into which Cu was diffused from a $Cu(NO_3)_2$-coated surface for 15 minutes at $\sim$710°C in H_2. The distance x_d from the surface at which the Cu concentration had dropped to $C_s/2$, where C_s is the concentration at the solubility limit for 710°C, varied from $\sim$0.004 cm in our most structurally perfect samples to >0.20 cm in samples containing multitudes of small-angle grain boundaries. Samples with large numbers of dislocations (10^4-10^6/cm^2), resulting from deformation at elevated temperatures, had x_d's between these limits. We have found that a good correlation exists between the rapidity of the Cu penetration and etch pit densities as brought out with *CP*4 and Superoxol (1 part 49% HF: 1 part 30% H_2O_2) on (111) planes. We have found no such correlation with very tiny etch pits brought out on (100) planes by slow etching, using a method reported by Ellis.[1]

If one assumes that the Cu transport obeys the usual laws of diffusion, then $x_d \simeq (Dt)^{\frac{1}{2}}$. For $t=15$ min and $T=710$°C, one obtains $D\sim 2\times 10^{-8}$ cm^2/sec for the most structurally perfect specimens and $D>4\times 10^{-5}$ cm^2/sec for the samples containing the small-angle boundaries. These values are to be compared with previously reported[2] results giving $D\sim 4\times 10^{-5}$ cm^2/sec in this temperature range. However, we do not feel that it is possible to assign values to the diffusion coefficient on this basis. More extensive measurements have shown that there are large departures from Fick's second law in this system, and that the mass transport of Cu cannot be characterized by a single diffusion coefficient at any given temperature.

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Effect of Melting on Positron Lifetime

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Positrons annihilating in some liquids and solids exhibit a complex two-photon annihilation lifetime.[1] Experimental and theoretical evidence seems to indicate the following: (1) A certain percentage of positrons form bound states (possibly positronium) prior to annihilation. (2) The shorter lifetime, τ_1 ($2-3\times 10^{-10}$ sec), results from free and bound singlet state annihilation, while the longer, τ_2($1-4\times 10^{-9}$ sec), is a reflection of either (a) conversion from bound triplet to bound singlet states and subsequent 2γ annihilation[2] or (b) a pick-off process in which a positron in the triplet bound state annihilates with an overlapping antiparallel atomic electron. Because of the low cross section of the spin flipping processes, the pick-off annihilation should be predominant.

The rate of triplet decay via τ_2 is apparently order-disorder-dependent, as indicated by the observed difference in τ_2 between crystalline and fused quartz.[1] To further examine this dependence, we have measured τ_2 in the molecular crystal naphthalene, as a function of temperatures extending across the melting point of