

taking into account the neighboring Fe-atoms up to the 6th nearest. The calculated value was estimated as 4.0×10^5 erg/cm³ at 0 K. The temperature dependence of K_1 taken into account K_d do not obey the third power function supposed for the crystalline field anisotropy. The value of K_1 may be due to the anisotropic exchange as well as the crystalline field anisotropy.

Since the ferromagnetic-paramagnetic transition at T_c is accompanied by the first order transition with a lattice distortion, the pressure variation of T_c , $\Delta T_c/\Delta p$, has to satisfy the thermodynamical Clausius Clapeyron equation;

$$\frac{\Delta T_c}{\Delta p} = \frac{\Delta V}{\Delta S}, \quad (3)$$

where ΔS and ΔV are the discontinuous jumps in the entropy and the volume at T_c , respectively. We have measured the variation of T_c under the hydrostatic pressures up to 6 kbar and obtained as $\Delta T_c/\Delta p = -3.46 \times 10^{-3}$ deg/bar. Using the value of ΔV obtained in this experiment, the magnitude of ΔS is estimated as 0.04 cal/mol·deg, which is relatively small for a first-order transition.

According to Rodbell and Bean,¹⁷⁾ if the exchange interaction which give rise to the magnetic ordering strongly depends upon the interatomic spacing, the Curie temperature T_c is expressed by the following equation,

$$T_c = T_0 \left(1 + \beta \frac{V - V_0}{V_0} \right), \quad (4)$$

where V_0 is the specific volume in the absence of exchange interaction, T_0 the Curie temperature of the rigid lattice and β the ratio between the changes of T_c and volume. On the basis of the molecular field approximation, the exchange striction at 0 K from the equilibrium condition is given by

$$\left(\frac{V - V_0}{V} \right) = \frac{3}{2} \frac{j^2}{j(j+1)} NkKT_0\beta. \quad (5)$$

Where j is the total angular momentum, K is the compressibility, N is the number of magnetic atoms per unit volume, k is the Boltzman constant. Here, if we define the parameter as

$$\eta = 40NkKT_0\beta^2 [j^2(j+1)^2 / (2j+1)^4 - 1], \quad (6)$$

we notice that for $\eta < 1$ the transition is of second order, while for $\eta > 1$, the transition is

of first order. If the ferromagnetic-paramagnetic transition is of first order, the volume change at T_c is given by

$$\left(\frac{\Delta V}{V} \right) = \frac{3}{2} \frac{j^2}{j(j+1)} NkKT_0\beta\sigma_c^2, \quad (7)$$

where σ_c is the jump of the relative magnetization at T_c . Also, the pressure variation of the Curie temperature can be derived from eq. (4) as,

$$\frac{\partial T_c}{\partial p} = -\beta KT_0. \quad (8)$$

We can estimate the exchange striction at 0 K and the volume change at T_c from eqs. (5), (6), (7) and (8). On substituting the value of K , T_0 , and $\Delta T_c/\Delta p$ into eq. (8), we have the value of $\beta = 28.8$. Here, we used the value of $K = 4.8 \times 10^{-13}$ cm²/dyne for Fe₂P measured by means of the X-ray diffraction under high pressure, which will be reported in near future, the value of $T_0 = 250$ K obtained by extrapolating the Brillouin function curve for $j = \frac{3}{2}$ to zero magnetization. On substituting the values of $\beta = 28.8$ and $j = \frac{3}{2}$ deduced by the magnetization at 0 K in eq. (6) we have $\eta = 1.20$. This suggests that the transition at T_c is of first order. The exchange striction at 0 K and the jump of volume at T_c are estimated to be 9.1×10^{-3} and 1.6×10^{-3} , from eqs. (5) and (7), respectively. Here, the value of σ_c was used 0.44 obtained from the jump of the hyperfine field at T_c determined by Wappling *et al.*¹¹⁾ These estimated values are in reasonable agreement with the experimental values of 9.5×10^{-3} and 0.64×10^{-3} , respectively. In conclusion, the ferromagnetic to paramagnetic transition at T_c of Fe₂P might be accompanied by the first-order transition with a lattice distortion due to magnetoelastic effects.

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...the exchange reaction at 0 K and the volume change in X from eq. (5) and (7) and (8). On substituting the value of λ in eq. (5) and (8), we have the value of $\lambda = 2.2 \times 10^{-2}$ cm³ for $\lambda = 7$ measured by means of the X-ray diffraction method which will be reported in near future, the value of $\lambda = 2.0 \times 10^{-2}$ cm³ is obtained by extrapolating the Brillouin function curve for $\lambda = 7$ to zero magnetization. On substituting the value of $\lambda = 2.2 \times 10^{-2}$ and $\lambda = 2$ deduced by the magnetization at 0 K in eq. (10) we have $\lambda = 1.70$ and $\lambda = 1.75$ for the reaction at $\lambda = 7$ and the value of λ is in first order of exchange reaction at 0 K and the value of λ is estimated to be 9.1×10^{-2} and 1.0×10^{-1} from eq. (2) and (7) respectively. Here, the value of λ was used 0.4 obtained from the form of the Brillouin function determined by Wäppling et al.¹¹ These estimated values are in reasonable agreement with the experimental value of 8.3×10^{-2} and 0.6×10^{-1} respectively. In conclusion, the ferromagnetic to paramagnetic transition at $\lambda = 7$ might be accompanied by the first order transition with a lattice distortion due to magnetostatic effects.

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$$T_c = T_0 \left(1 + \frac{N_A \chi}{10} \right) \quad (9)$$

where T_0 is the Curie temperature in the absence of exchange interaction, χ is the Curie susceptibility of the magnetic ions and N_A is the Avogadro's number. On the basis of the changes of λ and volume, the exchange interaction field approximation, the exchange reaction at 0 K from the equilibrium condition is given by

$$\frac{1 - \chi \lambda}{\chi \lambda} = \frac{1 - \chi \lambda}{\chi \lambda} \quad (10)$$

where χ is the total magnetic susceptibility, λ is the compressibility, V is the volume of magnetic ions per unit volume, ϵ is the Boltzmann constant. Here, λ we define the parameter as

$$\lambda = 10 \chi \lambda T_0 (1 + \chi \lambda)^{-1} \quad (11)$$

We notice that for $\lambda < 1$ the transition is of second order while for $\lambda > 1$ the transition is

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