parts. Such a study is in progress.

We should notice also that in a recent paper [44] we concluded erroneously that $\bar{\mu}_{Mn} \simeq 0$ in the $(Fe, Mn)_2B$ and $(Fe, Mn)_2Y$ systems, due to a systematic error in the determination of $\bar{H}_{Fe}$ as discussed earlier in this section.

Finally we mention that the present conclusion, that the magnetic moment of Mn is small but non-zero in these systems, is supported at least qualitatively by two other independent experimental results. Firstly, the average hyperfine fields at ^{55}Mn nuclei, determined with NMR [48], in $(Fe_{0.9}Mn_{0.1})_2B$ and $(Fe_{0.9}Mn_{0.1})_2Y$ were found to be about 190 and 125 kOe respectively. The ratio of average hyperfine field to magnetic moment is (118 ± 4) kOe/μ_B in ferromagnetic (Co, Mn)B compounds [49] and about 100 kOe/μ_B in other Mn-containing compounds [50]. Taking the accurately measured value of 118 kOe/μ_B, this would result in $\bar{\mu}_{Mn} \simeq 1.6\mu_B$ and $1.1\mu_B$ in $(Fe_{0.9}Mn_{0.1})_2B$ and $(Fe_{0.9}Mn_2)_2Y$ respectively, which values are relatively high compared with our result.

However, it is rather difficult to measure the low field part of the Mn hyperfine field distribution because of the reduced sensitivity of NMR at low frequencies.

Unfortunately, it is not possible to obtain $\bar{H}_{Mn}$ from the NMR-data for higher Mn-concentrations because the Mn resonance lines become too broad.

Secondly, also recent polarized neutron measurements [17] indicate the existence of magnetic moments on the Mn atoms in $(Fe, Mn)_2Y$ compounds.

7.5.

summary

It is shown in section 7.1. that the influence of topological disorder on the range of magnetic interactions in ferromagnetic transition metal-metalloid (TM-M) glasses, is much less than often assumed.
This is demonstrated via a study of the temperature dependence of the average iron hyperfine field $\bar{H}(T)$ in TM-M glasses assuming that $\bar{H}(T)$ is proportional to the average spontanuous magnetization $\bar{M}(T)$ not only at $T = 0$ but for $0 \leq T \leq T_c$.

In particular it is shown that the usual comparison between the

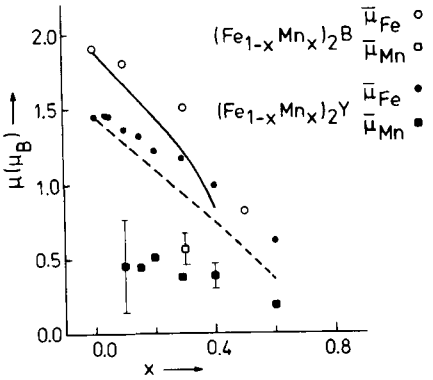

fig. 7.20.

Concentration dependence of the average magnetic moments of iron and manganese, $\bar{\mu}_{Fe}$ and $\bar{\mu}_{Mn}$, as calculated from the average moment per transition metal atom $\bar{\mu}_{TM}$ and the average iron hyperfine field $\bar{H}_{Fe}$, in the two pseudobinary compound systems. The full line and the dashed line give the concentration dependence of $\bar{\mu}_{TM}$ (fig. 7.17) in the two systems.

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glasses is inappropriate.
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magnetisation curves of the pure crystalline TM and those of the TM-M glasses is inappropriate. The latter are considerably lower ($\sim$ 25%) which would suggest the importance of short range magnetic interactions in the TM-M glasses. From the more appropriate comparison between the magnetisation curves of single phase crystalline $(Fe, Ni)_3B$ compounds and those of the glasses of the same composition we learn that the latter curves are not more than 5% lower. Furthermore it is shown that theoretical models which involve only nearest neighbour magnetic interactions cannot explain quantitatively this difference and the difference in Curie temperatures T_c of the crystalline and the amorphous alloys. Finally a more direct proof of the dominance of longe range mangetic interactions in ferromagnetic TM-M glasses is given.

In section 7.2. it is shown that the decrease of $\bar{H}(T)$, or $\bar{M}(T)$, at low temperatures in $Fe_{80-x}Ni_xP_{14}B_6$ ($0 \leq x \leq 60$) glasses follows a $T^{3/2}$-law in a large temperature range: $T \lesssim 0.5\ T_c$. The values of the coefficient B of the $T^{3/2}$ term in $\bar{H}(T) = \bar{H}(0)\ \{1 - B\ T^{3/2} .....\}$ are 5 to 10 times larger than those for the pure metals Fe and Ni. This is, again, often used as an argument for the importance of short range magnetic interactions in these glasses. However, in line with the results of section 7.1., the B-values for glasses are only about 2 times larger than those for the corresponding crystalline compounds. It is proposed that this relatively small difference can be explained by some reduction of the strength of the exchange coupling and some theoretical support for this proposition is mentioned.
Further it is shown that the coefficient B of a $T^{3/2}$ term in the resistivity in $Fe_{80-x}Ni_xP_{14}B_6$ glasses, present in the temperature range above the resistivity minimum (at $T \simeq 25$ K), is roughly proportional to the coefficient B of the $T^{3/2}$ term in $\bar{H}(T)$. This suggests a magnetic contribution to the resistivity which might prove to be helpful in solving the problem of the origin of the resistivity minimum in these glasses.

In sections 7.3. and 7.4. a study is reported of the behaviour of the 3d-magnetic moments in some amorphous and crystalline systems, in which Fe is the only magnetic component, when Ni or Mn are substituted for Fe. This information is obtained from the low-temperature average saturation moment per 3d-atom $\bar{\mu}_{TM}$ and the average iron hyperfine field

$\bar{H}$ (T = 0 K), using the proportionality between the average iron magnetic moment $\bar{\mu}_{Fe}$ and $\bar{H}$: $\bar{H} = a\bar{\mu}_{Fe}$. Also the change of the iron hyperfine field distribution P(H) with concentration was obtained.

The systems studied are:

i) amorphous $(Fe_{1-x}Ni_x)_{75+y}B_{25-y}$ $(0 \leq x \leq 0.8$; $y = 0,5,10)$,

ii) amorphous $(Fe_{1-x}Mn_x)_{78}B_{12}Si_{10}$ $(0 \leq x \leq 0.13)$,

iii) $(Fe_{1-x}Mn_x)_2B$ $(0 \leq x \leq 0.5)$, and

iv) $(Fe_{1-x}Mn_x)_2Y$ $(0 \leq x \leq 0.8)$ crystalline compounds.

In all systems $\bar{\mu}_{TM}$ descreases almost linearly with x : $\frac{d\bar{\mu}_{TM}}{dx} \simeq -1.8\mu_B$ in (i), - 4.8 μ_B in (ii), -2,7 μ_B in (iii) and - 1.8 μ_B in (iv).

In the two glassy systems the substitution of Ni has little effect on $\bar{\mu}_{Fe}$ and P(H) - and thus on the distribution of Fe moments - , whereas substitution of Mn reduces $\bar{\mu}_{Fe}$ and broadens P(H) strongly. The latter is also valid for the two crystalline compound systems. In the 4 systems Ni and Mn have relatively small magnetic moments and these are coupled ferromagnetically with the Fe-moments.

It is found that in system i) $\bar{\mu}_{Ni} = (+ 0.5 \pm 0.3)\mu_B$ in the whole concentration range tending to decrease somewhat with increasing x and in system ii) $\bar{\mu}_{Mn} = (+ 0.6 \pm 0.3)\mu_B$. In the crystalline compound systems iii) and iv) $\bar{\mu}_{Mn} = (+ 0.5 \pm 0.2)\mu_B$.

These results are compared with results from and assumptions made in the literature.

However a detailed interpretation of this new type of information is not possible until a study of the effect of substitution of all 3d-metals in these systems has been completed. Such a study is in progress for the glassy systems of type ii).

In the crystalline compound series iii) and iv) it is concluded from the concentration dependence of P(H) that:

i) the changes of the iron hyperfine field due to the Mn-substitution are not additive,

ii) it is not possible to decide whether the distribution of Mn (and Fe) atoms on the TM-sublattice is random or not.

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