Isothermal phase diagrams (H_p, P) for metamagnetic $Ni(NO_3)_2 \cdot 2H_2O$

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The magnetic field versus hydrostatic-pressure isothermal phase diagrams for $Ni(NO_3)_2 \cdot 2H_2O$ are presented. Each diagram exhibits a second-order line that merges into a first-order line as the pressure increases. Each diagram also exhibits a change in the curvature as the order of the transition changes.

We have obtained the applied magnetic field versus hydrostatic-pressure isothermal phase diagrams (H_p, P) for metamagnetic $Ni(NO_3)_2 \cdot 2H_2O$. These diagrams were constructed from isostatic phase diagrams (H_p, T) determined for the same set of temperature values (five of these isostatic diagrams were published in Ref. 1) and showed an unusual behavior for the phase boundaries that we report in Fig. 1. Each point in Fig. 1 was determined by a peak in the ac susceptibility curve[2] measured at a frequency of 10 Hz, corresponding to an isothermal curve χ_T for[3] $Ni(NO_3)_2 \cdot 2H_2O$. The peak field H_p is related to the internal field[4] by $H_{in} = H_p - NM$ where N is the demagnetizing factor and $M = M_\lambda$ for $T > T_t$, the tricritical temperature, and $M = (M^+ + M^-)/2$ for $T < T_t$, where $M^+(T)$ and $M^-(T)$ are the two branches in the (M, T) diagram for $T < T_t$. For the isothermal phase diagrams in Fig. 1, the circles refer to a second-order transition, the open triangles refer to a first-order one, and the closed triangles refer to a critical (possibly a tricritical) point. For five values of the pressure in Fig. 1, the order of the transition for each point was obtained by a direct inspection of our data.[1] For two other pressure values, the order of the transition (second order) was identified by a λ-like peak in the isothermal susceptibility curve. A dashed line was used in Fig. 1 as a guide to the eye; no fit was made. We can observe that each diagram in Fig. 1 exhibits a change in the line curvature as the order changes. These diagrams show that the critical (possible tricritical) point occurs at the inflection point. Such behavior for the phase boundaries does not occur for the isostatic phase diagrams (H_{in}, T)[4,5] or (H_p, T).[1,6] It will be useful to know the theoretical predictions for such a diagram but, to the best of our knowledge, it is not yet available in the literature. The dashed bold line joining the critical points shows clearly the condition $dT_c(P)/dH_c(P) < 0$ as observed in Ref. 1 for a 0–8 kbar pressure range. This condition attracted our attention because it implies that the possible tricritical point gets closer to the Néel temperature as the pressure increases.

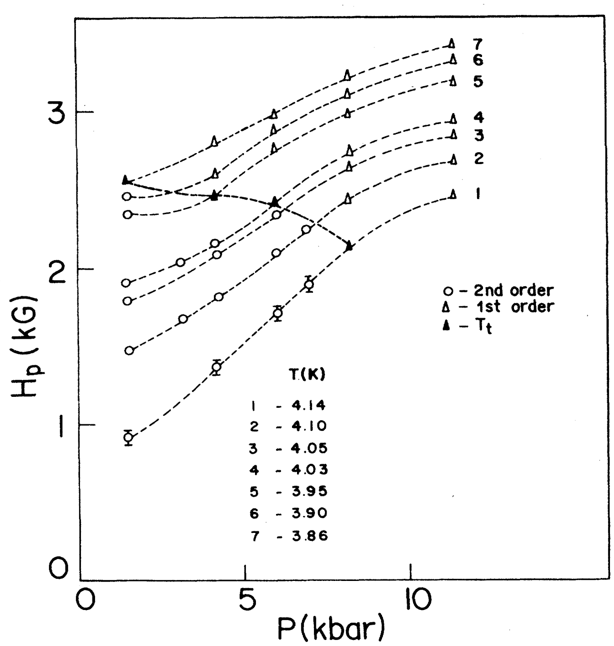

FIG. 1. Isothermal (H_p, P) diagrams as obtained for several temperatures. The circles refer to second-order transitions, the open triangles refer to first-order transitions, and the closed triangles refer to possible tricritical points.

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