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EFFECTS OF TEMPERATURE AND HYDROSTATIC PRESSURE ON INCLINED-FIELD AFMR IN $\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$

AFMR properties of $\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$ at low frequencies $\nu \approx 0.7 - 4.9 \text{ GHz}$ were studied as functions of hydrostatic head ($p = 0 - 11.2 \text{ kbar}$) and temperature ($T = 1.68 - 4.2^\circ \text{ K}$). Experimental results are compared with theoretical predictions. The magnetoelastic parameters are deduced which determine pressure variation of the exchange and relativistic AFM parameters.

LIST OF SYMBOLS

ν , cyclic frequency of the h. f. field; p , pressure; ψ , angle between the easy axis a and the external magnetic field, the latter oriented within the ab crystallographic plane; T , temperature; H_{1p} and H_{2p} , lower and upper resonance fields; ψ_f and H_f , AFMR failure angle and field; M_1 and M_2 , sublattice magnetic moments; δ and β , β' , ρ , ρ' , exchange parameter and magnetic anisotropy constants; $\chi_{||}$ and $\chi_{\perp}$, parallel and perpendicular magnetic susceptibility; $l_{||}$ and $l_{\perp}$, antiferromagnetic and «spin-flop» phases; H_{a1} and H_{a2} , fields corresponding to the zero-field AFMR frequencies; H_1 and H_{12} , fields determining the stability region of the $l_{||}$ phase with the magnetic sublattices flopping into either ab or ac plane, respectively; H_{Π} , field at which the both phases are in equilibrium; ω , angular frequency; $\omega_{2\min}$ and $H_{2\min}$, frequency and field corresponding to the minimum on the $\omega_2(H)$ dependence at $\psi > \psi_k$; $\psi_k \approx (\rho_0 + \rho')/4\delta$; $\omega_0 = \omega/\gamma H_c$; $H_{||}^{(2)}$, resonance field of branch ω_2 of the $l_{||}$ phase; H_m , field of the resonance isogon maximum; $\omega_{\perp}(H)$, resonance frequency for the $l_{\perp}$ phase.

FIGURE CAPTIONS

Fig 1. High-pressure chamber.

Fig 2. Dependence $H_p(\psi)$ for various frequencies ν (in GHz) and pressures (in kbar) at $T = 1.68^\circ \text{K}$: $p_1 = 0$, $\nu_2 = 3.14$ (●), $\nu_3 = 4.88$ (○); $p_2 = 5.2$, $\nu_2 = 3.1$ (▲), $\nu_3 = 4.65$ (△); $p_3 = 9.2$, $\nu_2 = 2.95$ (▼); $\nu_3 = 4.60$ (▽); $p_4 = 11.2$, $\nu_2 = 2.85$ (■), $\nu_3 = 4.48$ (□). The solid lines are calculated for p_1 , ν_3 and p_2 , ν_3 .

Fig 3. Resonance fields and failure angle ψ_f as functions of pressure at $T = 1.68^\circ \text{K}$ and $\nu = 3 \text{ GHz}$: ○ — H_{1p} ; △ — H_{2p} ; □ — H_f ; ▼ — ψ_f .

Fig 4. Constant-pressure dependences $H_f(\nu)$, $\psi_f(\nu)$ at $T = 1.68^\circ \text{K}$: ▽ — H_f , ○ — ψ_f at $p_1 = 0$; ▼ — H_f , ● — ψ_f at $p_4 = 11.2 \text{ kbar}$. The solid lines are calculated $H_f(\nu)$ and $\psi_f(\nu)$.

Fig 5. Dependence $H_p(\psi)$ for various temperatures, frequencies (in GHz) and pressures p (in kbar): $p_1 = 0$, $\nu_1 = 0.76$, $\nu_2 = 3.14$, $\nu_3 = 4.88$; $p_2 = 5.2$, $\nu_1 = 0.73$, $\nu_2 = 3.1$, $\nu_3 = 4.65$; $p_3 = 9.2$, $\nu_1 = 0.68$, $\nu_2 = 2.29$, $\nu_3 = 4.60$; $p_4 = 11.2$, $\nu_1 = 0.64$, $\nu_2 = 2.85$, $\nu_3 = 4.48$; ν_1 — △, ν_2 — ×, ν_3 — ○, □, ◇.

Fig 6. The resonance fields as functions of temperature at various pressures p (in kbar) and frequencies ν (in GHz): $p_1 = 0$, $\nu_2 = 3.14$ (×), $\nu_3 = 4.88$ (○); $p_2 = 5.2$, $\nu_2 = 3.1$ (×); $\nu_3 = 4.65$ (□); $p_4 = 11.2$, $\nu_2 = 2.85$ (×); $\nu_3 = 4.48$ (◇). The solid lines are calculations for p_1 , ν_3 and p_4 , ν_3 .

Fig 7. H_f and ψ_f versus temperature: $p_1 = 0$, $\nu_3 = 4.88 \text{ GHz}$, □ — H_f , ○ — ψ_f ; $p_2 = 9.2 \text{ kbar}$, $\nu_3 = 4.60 \text{ GHz}$, ■ — H_f , ● — ψ_f . The solid lines are calculations.