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EFFECTS OF TEMPERATURE AND HYDROSTATIC PRESSURE ON INCLINED-FIELD AFMR IN $CuCl_2 \cdot 2H_2O$

AFMR properties of $CuCl_2 \cdot 2H_2O$ at low frequencies $\nu \approx 0.7 - 4.9\,GHz$ were studied as functions of hydrostatic head ($p = 0 - 11.2$ *kbar*) and temperature ($T = 1.68 - 4.2°$ 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; $\chi_{\parallel}$ and $\chi_{\perp}$, parallel and perpendicular magnetic susceptibility; $l_{\parallel}$ 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 $l_{\parallel}$ phase with the magnetic sublattices flopping into either ab or ac plane, respectively; $H_{\text{п}}$, 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 $\psi > \psi_k$; $\psi_k \approx (\rho_0 + \rho')/4\delta$; $\omega_0 = \omega/\gamma H_c$; $H_{\parallel}^{(2)}$, resonance field of branch ω_2 of the $l_{\parallel}$ 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 $T = 1.68°$ 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 $T = 1.68°$ K and $\nu = 3\,GHz$: ○ — H_{1p}; △ — H_{2p}; □ — H_f; ▼ — ψ_f.

Fig. 4. Constant-pressure dependences $H_f(\nu)$, $\psi_f(\nu)$ at $T = 1.68°$ K: ▽ — H_f, ○ — ψ_f at $p_1 = 0$; ▼ — H_f, ● — ψ_f at $p_4 = 11.2$ *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*): $p_1 = 0$, $\nu_1 = 0.76$, $\nu_2 = 3.14$, $\nu_3 = 4.88$; $p_2 = 52$, $\nu_1 = 0.73$, $\nu_2 = 3.1$, $\nu_3 = 4.65$; $p_3 = 9.2$, $\nu_1 = 0.68$, $\nu_2 = 2.29$, $\nu_3 = 4.60$; $p_4 = 11.2$, $\nu_1 = 0.64$, $\nu_2 = 2.85$, $\nu_3 = 4.48$; 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: $p_1 = 0$, $\nu_3 = 4.88$ *GHz*, □ — H_f, ○ — ψ_f; $p_2 = 9.2$ *kbar*, $\nu_3 = 4.60$ *GHz*, ■ — H_f, ● — ψ_f. The solid lines are calculations.