

Crystal and thermodynamic properties of Tb₂Ni₂X (X = Al, Ga)

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The crystal and thermodynamic properties of Tb₂Ni₂X (X = Al, Ga) are reported through measurements of X-ray diffraction (XRD), magnetic susceptibility, $\chi(T)$, magnetization, $M(\mu_0H)$ and heat capacity, $C_p(T)$. XRD pattern analysis confirms the orthorhombic W₂CoB₂-type with the space group of Immm. $\chi(T)$ at high temperature for both compounds follows the Curie–Weiss relationship giving an effective magnetic moment close to that expected for the trivalent Tb ion. The low-temperature $\chi(T)/C_p(T)$ data indicate that both compounds order antiferromagnetically at $T_N = 41$ K / 40.4 K and 41.5 K / 41.4 K for Al and Ga compounds, respectively. $C_p(T)$ data of the nonmagnetic counterparts Y₂Ni₂X (X = Al, Ga) are well described by the Debye model given a Debye temperature, $\theta_D = 236.9(4)$ K and 225.3(2) K for Al and Ga compounds, respectively. The low-temperature of the 4f-magnetic contribution to the total heat capacity, $C_{4f}(T)$ data can be well approximated according to the antiferromagnetic spin–wave dispersion, giving an energy gap $\Delta_{sw} = 4.1(3)$ meV and 2.2(2) meV for Al and Ga compounds, respectively. The 4f –magnetic entropy $S_{4f}(T)$ for both compounds reaches the values of $2R\ln(2)$ close to their respective T_N values.

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