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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, χ(T), magnetization, M(μ0H) and heat capacity, Cp(T). XRD pattern analysis confirms the orthorhombic W2CoB2-type with the space group of Immm. χ(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 χ(T)/Cp(T) data indicate that both compounds order antiferromagnetically at TN = 41 K / 40.4 K and 41.5 K / 41.4 K for Al and Ga compounds, respectively. Cp(T) data of the nonmagnetic counterparts Y2Ni2X (X = Al, Ga) are well described by the Debye model given a Debye temperature, θD = 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, C4f (T) data can be well approximated according to the antiferromagnetic spin–wave dispersion, giving an energy gap Δsw = 4.1(3) meV and 2.2(2) meV for Al and Ga compounds, respectively. The 4f –magnetic entropy S4f (T) for both compounds reaches the values of 2Rln(2) close to their respective TN values.

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