Thermal evolution of magnetic structures in R_2Ni_2In (R = Tb and Ho)

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Thermal evolution of magnetic structures in R_2Ni_2In (R = Tb and Ho) has been studied by powder neutron diffraction at low temperatures. The experimental data reveal that the compounds crystallize in an orthorhombic crystal structure of the Mn_2AlB_2-type. In magnetically ordered state, the localized magnetic moments have been found solely on the rare earth atoms. Both compounds show antiferromagnetic ordering at low temperatures. A collinear commensurate magnetic structure, related to the propagation vector $\mathbf{k} = [\frac{1}{2}, \frac{1}{2}, \frac{1}{2}]$, is observed in Tb_2Ni_2In. The Tb magnetic moments are parallel to the c-axis. The structure does not change with temperature. In contrary, the magnetic structure of Ho_2Ni_2In shows strong temperature dependence. Below the Néel temperature, an incommensurate sinusoidal structure ($\mathbf{k}_1 = [0.24, 1, 0.52]$) is observed. With decreasing temperature, the structure turns into incommensurate square-modulated one, described by $\mathbf{k}_2 = [0.17, \frac{5}{6}, \frac{1}{2}]$ (the component along the a-axis slightly differs from commensurate value) and its third harmonics $3\mathbf{k}_2 = [0.50, \frac{5}{2}, \frac{3}{2}]$. According to heat capacity data, the transition between the sinusoidal and square-modulated structures is of the first order type. Further decrease of temperature leads to reappearance of the sinusoidal structure and coexistence of both detected magnetic structures. The Ho magnetic moments remain parallel to the c-axis in both the sine- and square-modulated magnetic structures.

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