High-pressure Synthesis and Structural, Electrical and Magnetic Properties of a New Filled Skutterudite $TbFe_4P_{12}$

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The new filled skutterudite $TbFe_4P_{12}$ has been prepared at around 4 GPa and 1050 °C. Powder X-ray diffraction of TbT_4P_{12} (T = Fe and Ru) has been studied with synchrotron radiation at ambient pressure. The crystal structures of both compounds were refined by Rietveld methods at ambient pressure. The positional parameters, bond lengths and bond angles have been obtained for TbT_4P_{12} (T = Fe and Ru). The electrical and magnetic properties of $TbFe_4P_{12}$ have been investigated at low temperatures. The susceptibility of this phosphide follows a Curie-Weiss behavior at higher temperatures. The linear slope of the χ^{-1} *vs.* T curve from 15 to 300 K yields an effective magnetic moment of 9.48 μ_B. This value is close to the magnetic moment of the Tb^{3+} ion calculated from Hund's rule, 9.72 μ_B. The ferromagnetic transition of $TbFe_4P_{12}$ was observed at around 10 K, and an electrical anomaly based on the magnetic ordering was detected. The relationship between the crystal structure and the physical properties of TbT_4P_{12} (T = Fe and Ru) is discussed.

Key words: High-pressure Synthesis, Crystal Structure, Electrical and Magnetic Properties, Filled Skutterudite, $TbFe_4P_{12}$