Magnetic and transport properties of Tm_2MgSi_2

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The ternary intermetallic compound Tm_2MgSi_2 is crystallizes in the tetragonal Mo_2FeB_2-type structure with space group *P*4/*mbm* [1]. The physical properties of this compound have not been reported hitherto. The single-phase polycrystalline sample of Tm_2MgSi_2 has been prepared by using an encapsulated molybdenum crucible. The excess magnesium, which is the constituent of this compound, has been sealed in the crucible as a flux. The X-ray powder diffraction exhibits only the characteristic lines of the Mo_2FeB_2-type structure. The temperature dependence of magnetic susceptibility shows the cusp, implying the antiferromagnetic ordering, and the corresponding specific heat anomaly is observed around T_N = 5.6 K. The $\chi^{-1} - T$ curve satisfies the Curie-Weiss law above 100 K. The paramagnetic Curie temperature and effective magnetic moment are determined to be θ_P = -5.1 K and μ_{eff} = 7.45 μ_B, respectively. This value of μ_{eff} is in good agreement with the theoretical one for the Tm^{3+}. The entropy associated with this magnetic ordering is estimated to be $R\ln 2$ around T_N. Therefore, it is suggested that the crystalline electric field (CEF) ground state is doublet or two close-lying singlets. The electrical resistivity measurements reveal the metallic behavior between 300 K and 20 K, however, the resistivity shows the abrupt increase around T_N. This anomaly is suppressed by applying magnetic fields, which eventually exhibits metallic behavior at B = 9 T. These features considered to be attributed to the formation of a magnetic superzone gap.

[1] R. Kraft and R. Pöttgen , Monatsh. Chem., **136**, 1707 (2005).

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