NMR studies of Heusler-type intermetallic antiferromagnet Mn_3Si

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Itinerant electron antiferromagnet Mn_3Si is an intermetallic compound with a cubic crystal structure of the Heusler-type. Mn atoms are occupied on two different sites of Mn(I) and Mn(II), whose atoms have different magnetic moments due to their different nearest-neighbor configurations, Mn_3Si becomes antiferromagnetic state below the Néel temperature of T_N=23 K with a spin density wave (SDW). According to neutron diffraction studies, the most probable spin structure is a transverse sinusoidal structure (TSS), in which the maximum amplitudes of magnetic moments for Mn(I) and Mn(II) were determined as 2.4 and 0.28 μ_B, respectively. In order to investigate the physical properties of Mn_3Si microscopically, the ^{55}Mn NMR have been carried out for both paramagnetic and antiferromagnetic phases in the temperature region between 2.2 and 300 K. The temperature dependences of line width, Knight shift and spin-lattice relaxation time T_1 of ^{55}Mn NMR have been measured for both phases. In the antiferromagnetic phase, two different spectra corresponding to Mn(I) and Mn(II) sites are found at the resonance frequencies of 145 and 6 MHz, respectively, at 4.2 K. From these results, the internal magnetic fields on ^{55}Mn(I) and ^{55}Mn(II) nuclei are obtained to be 13.6 and 0.6 T, respectively. According to NMR results, a helical structure in Mn spin states is well explained compared with the TSS.