Hyperfine field at La in the intermetallic compound $LaMnSi_2$ measured by PAC using ^{140}Ce nuclear probe

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Magnetic hyperfine field has been measured in the orthorhombic intermetallic compound $LaMnSi_2$ with PAC spectroscopy using radioactive ^{140}La-^{140}Ce nuclear probes. Magnetization measurement was also carried out in this compound with MPSM-SQUID magnetometer. The $LaMnSi_2$ sample was prepared by melting pure metallic components in stoichiometric proportions in an arc furnace under argon atmosphere. After melting, the sample was annealed at 1000 ^{o}C for 60h under helium atmosphere and then quenched in to water. X-ray analysis confirmed the sample to be in a single phase with correct crystal structure expected for $LaMnSi_2$. The radioactive nuclei, ^{140}La ($T_{1/2}$ = 40h) were produced by direct irradiation of the sample with neutrons in the IEA-R1 nuclear research reactor at IPEN with a flux of ~10^{13} $ncm^{-2}s^{-1}$ for about 3-4 min. The irradiated sample was annealed at 1000 ^{o} C under helium atmosphere for 24 hours before starting the PAC measurement in order to minimize the effects of eventual radiation damage by fast neutrons during irradiation as well as to allow the decay of the short lived ^{56}Mn ($T_{1/2}$ = 2.6h) activity also produced in the sample. The PAC measurements were carried out with a six BaF_2 detector spectrometer at several temperatures between 10 K and 400 K. The results showed well defined magnetic dipole interaction at all temperatures. Temperature dependence of the hyperfine field, B_{hf} was found to be anomalous. The magnetization measurement however, showed no anomaly. Therefore, the anomalous behavior of B_{hf} may be attributed to the interaction where ^{1}f electron of the dilute Ce atom is spin polarized by the magnetic field from Mn sublattice and contributes to the effective hyperfine field. The ferromagnetic transition temperature (T_C) of $LaMnSi_2$ was determined to be 400(1) K confirming by magnetic measurement and the earlier results.