High-field study of magnetization and magnetoacoustics in UCo_2Si_2

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Magnetic and magnetoacoustic properties in uranium antiferromagnet UCo_2Si_2 have been studied at 1.4-100 K. Since the uranium compounds have huge magnetic anisotropy, the study has been performed on the single crystals (grown by the Czochralski method in a tri-arc furnace) in pulsed magnetic fields up to 60 T. The U magnetic moments of 1.4 μ_B in UCo_2Si_2 (T_N = 82.5 K) lie along the c axis of the tetragonal lattice. The ferromagnetic c-planes alter along the c axis in a simple +- sequence. In magnetic fields applied along the c axis, we observed the metamagnetic transition (MT) in 45 T (at 1.4 K). The MT is extremely sharp and is certainly of the first order, but exhibits a very small hysteresis. With increasing temperature, the MT becomes broader and vanishes at T_N. The magnetization gain upon the MT corresponds roughly to 1/3 of the U magnetic moment. For this reason, we suppose that the state above the MT is ferrimagnetic with the ++- arrangement of the magnetic moments like in the isostructural analogue UNi_2Si_2 where this magnetic structure is realized in the ground state. In fields applied along the a axis of the UCo_2Si_2 single crystal, only a linear paramagnetic behavior with weak temperature dependence is observed. The ultrasound measurements confirm the transition, which is accompanied by very sharp anomalies in both sound velocity and sound attenuation, and show its rather complicated temperature evolution.