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Elastic properties of $SmRu_4P_{12}$ in pulsed magnetic fields

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We performed ultrasonic measurements in pulsed high magnetic fields up to 35 T for the filled skutterudite compound $SmRu_4P_{12}$. This compound shows two successive transitions at $T_{MI} = 16$ K (metal-insulator transition) and at $T_N = 14$ (magnetic transition) [1]. The origin of the transitions is not clear so far and multipolar interactions including octupole and quadrupole is suggested to play an important role [2]. In this work, ultrasound velocity and attenuation were measured simultaneously by detecting the ultrasound echo of the sample in two 90° shifted channels in 14 msec. The three modes C_{11}, C_{44} and $(C_{11}\text{-}C_{12})/2$ were measured at different temperatures. In figure 1 (left) we see two symmetrical raw data curves ($V1$, $V2$) with respect to magnetic field B, which were obtained at 14 K. Figure 1 (right) is the calculated elastic constant and attenuation based on the raw data, where we notice a steep increase in C_{11} and a sharp peak in β_{11} curve at 8 T. Such anomalies are supposed to be due to the II-III phase transition in $SmRu_4P_{12}$. The enhancement of attenuation from II to III phase is not understood yet. At other temperatures we observed similar behaviors too, with moderate changes of elastic constant and attenuation compared with those at 14 K. The observed critical fields for different temperatures show large discrepancy with the reported phase diagram.

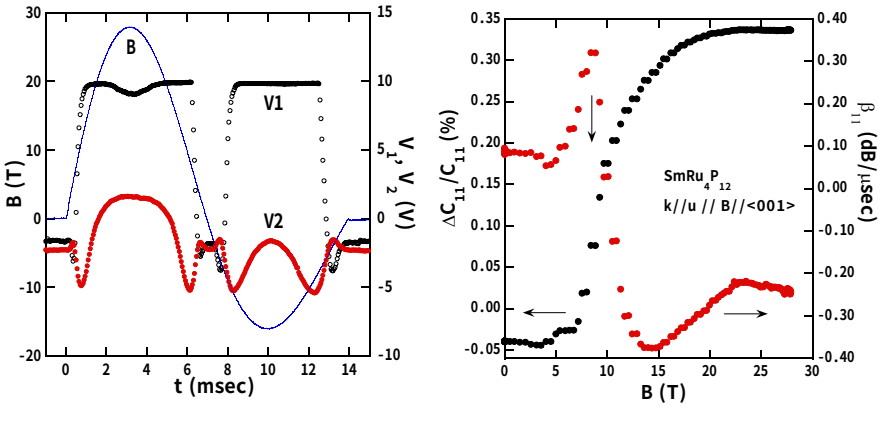

Figure 1: The raw data of magnetic field and two voltages obtained at 14 K (left panel). The elastic constant C_{11} and ultrasound attenuation β_{11} as a function of magnetic field at 14 K (right panel).

[1] C. Sekine, *et al.*, in *Science and Technology of High Pressure*, ed. M. H. Manghnani, W. J. Nellis and M. F. Nicol (Universities Press, Hyderabad, India, 2000) p. 826.

[2] M. Yoshizawa *et al.*, J. Phy. Soc. Jpn. **74** (2005) 2141.