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Elastic properties of La-substituted system $Pr_xLa_{1-x}Fe_4P_{12}$ with being x=0.95

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$PrFe_4P_{12}$ has been under intensive investigation, since it exhibits anomalous heavy fermion (HF) behaviors with a distinct phase transition (ODP) at 6.2 K. Although a lot of the physical reports have been published, the mechanism of a formation of $4f^2$-based heavy fermion state have not been clarified, yet. Besides, the ground state of 4f levels of Pr ion has not been determined, yet. Ultrasonic measurement allows to study directly the ground state property of 4f-multiplets split by crystalline electric field (CEF) effect at low temperatures. We have extended our study on $PrFe_4P_{12}$ by means of ultrasonic measurement to the La-substituted system, $(Pr_xLa_{1-x})Fe_4P_{12}$. The La-doping leads to a rapid disappearance of ODP and appearance of a new ferromagnetic (FM) transition. After the complete disappearance of ODA by La-doping, the HF behavior is recovered. Figure 1 shows the temperature dependence of elastic constants. A pronounced elastic softening towards low temperatures was observed. Interestingly, a precursor hump was also observed. We will discuss the origin of the observed softening and the ground state property of Pr ion in this system.

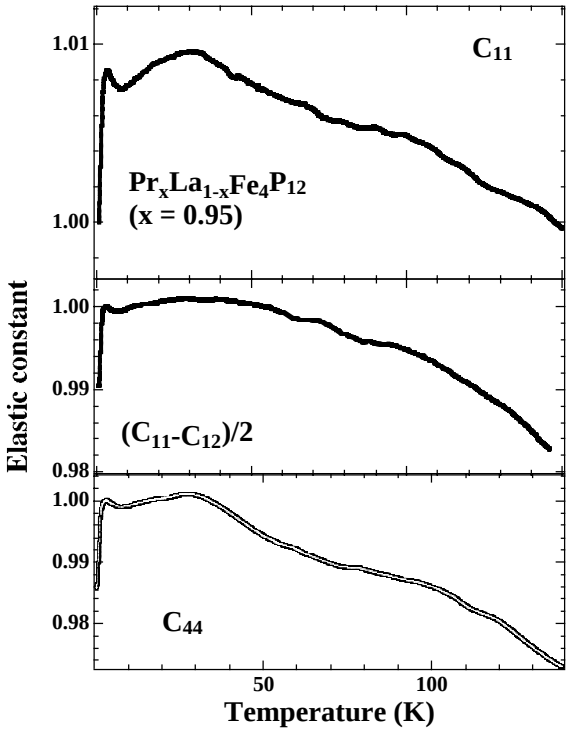

Figure 1: Temperature dependence of the elastic constants, C_{11}, $(C_{11}- C_{12})/2$ and C_{44} of $Pr_xLa_{1-x}Fe_4P_{12}$: x=0.95.