Ultrasonic Investigations on Layerd Iron Pnictide Superconductor $Ba(Fe_{0.9}Co_{0.1})_2As_2$

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We have carried out ultrasonic pulse echo measurements on single crystals of iron pnicitde $Ba(Fe_{0.9}Co_{0.1})_2As_2$ with optimal superconducting transition temperature of $T_{SC} = 23$ K. The shear elastic constant C_{66} associated with elastic strain ε_{xy} reveals considerable softening of 28 % below 300 K down to T_{SC} and turns to increasing in superconducting phase below T_{SC}, while other shear elastic constants of $(C_{11} - C_{12})/2$ and C_{44} and longitudinal ones of C_{11} and C_{33} show no sigh of softening. The softening of C_{66} is well described by $C_{66} = C_{66}^0(1 - \Delta/(T - \Theta))$ with $\Theta = -47.5$ K and $\Delta = 20$ K. The negative Weiss temperature Θ indicates antiferro-quadrupole interaction in the system. The softening in C_{66} is robust in applied magnetic fields. The present ultrasonic experiments indicate that the quadrupole associated with degenerate $d_{y'z}$ and $d_{zx'}$ bands participates in the superconductivity of the present iron pnicitde system. The plausible superconductivity symmetry s_{++} in the iron pnicitde will be argued.