Ultrasonic study of structural phase transition on Fe(Te,S)

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S-substituted FeTe is one of the 11-type iron-based superconductors (IBSs). The parent material FeTe does not exhibit superconductivity (SC), while it shows antiferromagnetism (AFM) accompanying a structural phase transition (SPT) from tetragonal ($P4/nmm$) to monoclinic ($P2_1/m$) around 70 K [1]. By substituting sulfur for tellurium, the AFM and SPT are suppressed. SC is induced by annealing process for an as-grown sample, because the SC is suppressed due to the magnetism of the excess iron [2]. Therefore, the origin of AFM and SPT as well as their quantum fluctuations are important to understand the mechanism of the SC in Fe(Te,S).

To investigate the origin of the SC in Fe(Te,S), we measured the temperature dependence of the elastic stiffness constants C using ultrasonic measurements. The elastic constant C shows a softening of 30% for temperatures between 200 K and about 10 K, which is consistent with the AFM and SPT temperatures (Fig.1). This elastic behavior is comparable to that in 122-type IBSs [3]. Based on the magnetic field dependence of the elastic constant in pulsed magnetic fields of up to 50 T, we will discuss the origin of the elastic softening in Fe(Te,S).

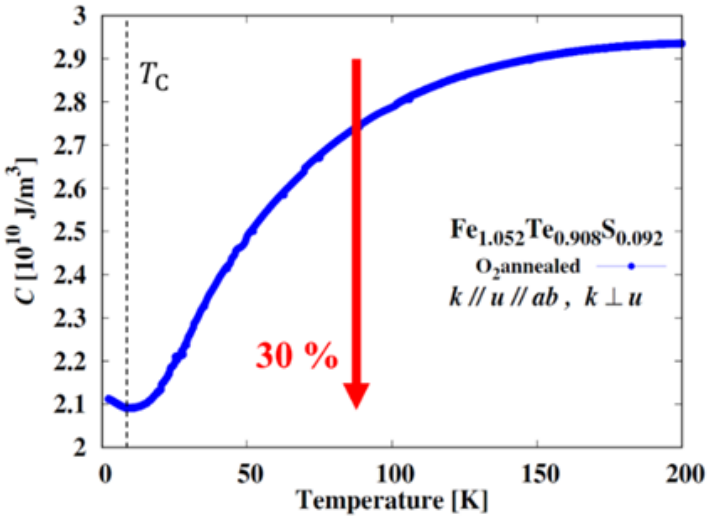

Figure.1 Temperature dependence of C for $Fe_{1+y}Te_{1-x}S_x$ annealed under an oxygen atmosphere. In this measurement, the ultrasonic mode is a transverse wave, propagation direction ***k*** and polarization direction ***u*** are along ***ab*** plane.

References

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