INFLUENCE OF HYDROSTATIC PRESSURE ON SUPERCONDUCTIVITY OF Sr_2RuO_4

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Introduction

The layered Sr_2RuO_4 crystalline material is famous for its unusual intriguing spin-triplet electron coupling [1]. However, the mechanism of this coupling and the symmetry of the superconducting gap in this material are not completely established yet. To obtain additional information on it's the electronic structure and to clarify the relationship between elastic and magnetic properties of this unconventional superconductor, we performed investigation of magnetoacoustic properties of its superconducting transition under application of several values of hydrostatic pressure.

Experiment and Results

We studied the longitudinal (c_{11}) ultrasound (f = 60-350 MHz) wave propagated along [100] direction in Sr_2RuO_4 single crystal, placed in a nonmagnetic pressure cell. All experiment was done upon increase of pressure. The work was performed in an 18 Tesla superconducting magnet at temperatures down to 0.3K.

The measurements revealed a number of new phenomena. With application of a hydrostatic pressure, the time of flight of a sound pulse through the crystal decreased significantly. Due to the small change of the sample size [2] this means an increase in the sound speed, as shown in Fig.1 (a). As in the previous works [3,4] the pressure reduces the temperature of the superconducting transition T_C [Fig.1 (b)]. This decrease follows a linear law with the negative slope of -0.021 K/kbar. It is remarkable, that the slope value is the same as in [3,4]. The pressure also causes approximately linear decrease of lower H_{C1} and upper H_{C2} values of the critical field [Fig.1 (b)] with the slopes of -0.033 and -0.027 K/kbar correspondingly. Below T_C the temperature dependence of the sound attenuation follows a power law. The power law exponent increases with the pressure growth [Fig.1 (c)]. From comparison of the temperature (at zero field) and magnetic field (at fixed temperature) dependences of the attenuation, we extracted the *absolute* value of the phonon contribution to the normal state sound attenuation. Figure 1 (d) shows that this phonon contribution decreases with pressure.

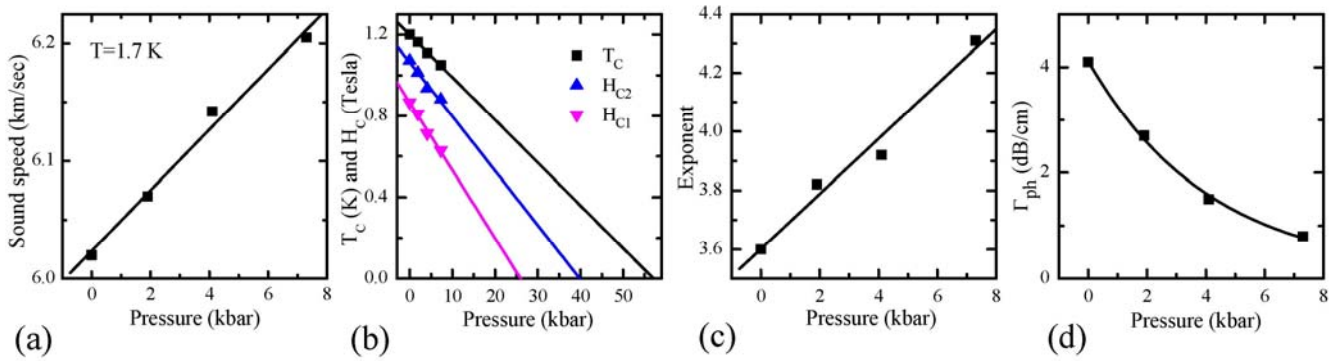

Fig. 1. Pressure dependences of Sr_2RuO_4 properties: sound speed (a); critical temperatures and magnetic fields (b); power law exponent (c); and phonon contribution to the sound attenuation (d), solid line is a guide for the eye.

Acknowledgements

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References

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