Supplemental Material: In-plane anisotropic response to the uniaxial pressure in the hidden order state of URu_2Si_2

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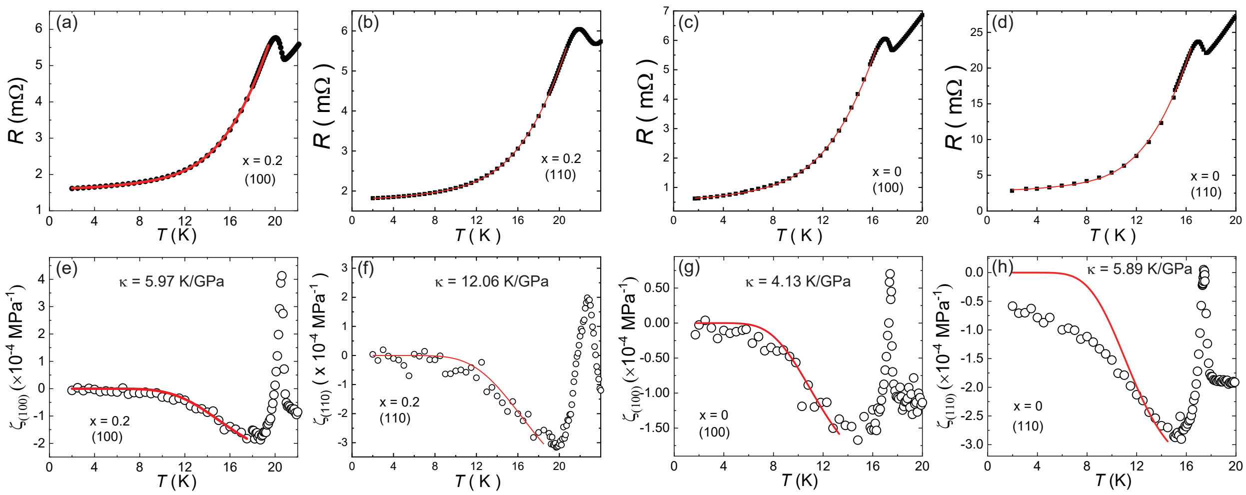

FIG. S1. (a)-(d) Temperature dependence of resistance for $x = 0.2$ and 0 along the (100) and (110) directions. The solid lines are fitted results by Eq. (1). (e)-(h) Temperature dependence of ζ for $x = 0.2$ and 0 along the (100) and (110) directions. The solid lines are calculated results by Eq. (2).

I. CALCULATING THE ELASTORESISTIVITY BASED ON THE GAP FUNCTIONS

In the manuscript, we have shown that the temperature dependence of the elastoresistivity ζ above T_0 in the $URu_{2-x}Fe_xSi_2$ system can be simply explained as the uniaxial-pressure effect on an energy scale, which is most likely T^*. This scenario can be also applied below T_0 except for the $x = 0$ sample along the (110) direction. Since the temperature dependence of the resistivity has long been known to be described by some gap functions [1, 2], the energy scale should be associated with the gap. Here we take a simple form as follows [1],

$$\rho = \rho_0 + AT^2 + \frac{BT}{\Delta}(1 + \frac{2T}{\Delta})e^{-\frac{\Delta}{T}}, \tag{1}$$

where Δ is the gap associated with the HO transition. It is reasonable to assume that the application of pressure changes Δ as $\Delta \approx \Delta_0 + \kappa p$ when the pressure is small. Therefore, the resistivity change under pressure is proportional to $d\rho/d\Delta$, which is

$$\frac{d\rho}{d\Delta} = -\frac{B}{\Delta}(1 + \frac{3T}{\Delta} + \frac{4T^2}{\Delta^2})e^{-\frac{\Delta}{T}}. \tag{2}$$

We can thus fit the temperature dependence of the resistance below T_0 with Eq. (1) [Fig. S1(a)-S1(d)] and calculate $dR/d\Delta$ according to Eq. (2). It is clear that the calculated

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results match the measured ζ well for all the samples except the $x = 0$ sample along the (110) direction.

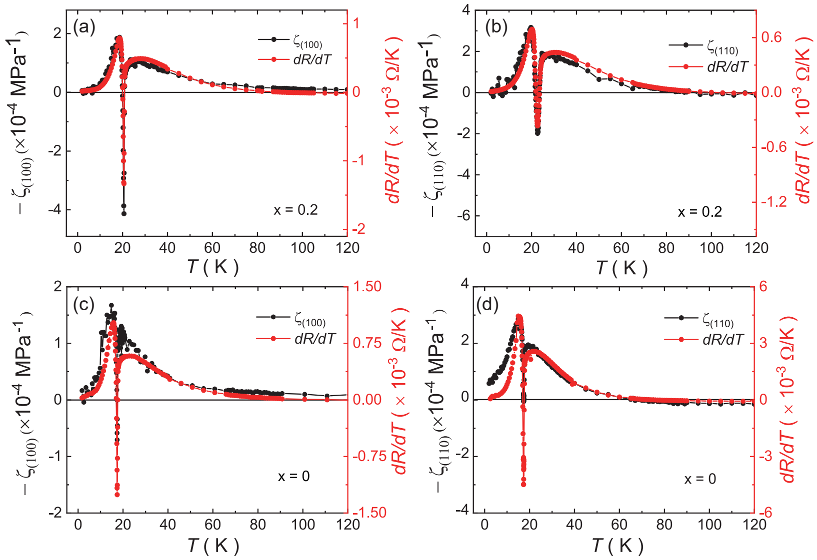

FIG. S2. Comparison between $-\zeta$ and dR/dT for (a) $x = 0.2$ and p // (100), (b) $x = 0.2$ and p // (110), (c) $x = 0$ and p // (100), and (d) $x = 0$ and p // (110).

II. COMPARISON BETWEEN ζ AND dR/dT

We have pointed it out in the manuscript that the temperature dependence of ζ and dR/dT are very similar. Fig. S2 shows the comparison between $-\zeta$ and dR/dT for all the samples. Again, all of them match well expcet for the $x = 0$ sample along the (110) direction below T_0.

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[2] S. Ran, C. T. Wolowiec, I. Jeon, N. Pouse, N. Kanchanavatee, B. D. White, K. Huang, D. Martien, T. DaPron, D. Snow, M. Williamsen, S. Spagna, P. S. Riseborough, and M. B. Maple, Phase diagram and thermal expansion measurements on the system $URu_{2-x}Fe_xSi_2$, Proc. Natl. Acad. Sci. U.S.A **113**, 13348 (2016).