

Flux pinning and vortex dynamics of iron-based superconductors

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Investigation of vortex pinning and its dynamics is of great importance for both the microscopic physics and technological applications in the field of superconductivity. In this talk, we will discuss some of our results on vortex physics of two distinct systems of iron-based superconductors (IBSs), $\text{Ca}_{0.8}\text{La}_{0.2}\text{Fe}_{0.978}\text{Co}_{0.022}\text{As}_2$ (FeAs-112-type) [1] and $\text{Li}_{0.8}\text{Fe}_{0.2}\text{OHFeSe}$ (FeSe-1111-type) [2]. The magnetization hysteresis loop exhibits a pronounced second peak effect in $\text{Ca}_{0.8}\text{La}_{0.2}\text{Fe}_{0.978}\text{Co}_{0.022}\text{As}_2$ while it is absent in $\text{Li}_{0.8}\text{Fe}_{0.2}\text{OHFeSe}$. Detailed analyses suggest that the second peak is strongly associated with a crossover from elastic to plastic vortex creep. To better understand the second peak phenomenon, related physical scenarios as well as the affecting factors in the second peak occurrence are demonstrated (Figure (a)-(c)). Besides, the obtained creep exponent μ based on the collective creep theory is ~ 1.21 in $\text{Ca}_{0.8}\text{La}_{0.2}\text{Fe}_{0.978}\text{Co}_{0.022}\text{As}_2$, which is close to many other IBSs. But the value of μ in $\text{Li}_{0.8}\text{Fe}_{0.2}\text{OHFeSe}$ is found to be ~ 4.1 much larger than the predicted maximum value. Such a large value of μ may be originated from the weakening of coupling between the vortices in neighboring layers by elongating the layer distance. It may indicate that the vortex structure of $\text{Li}_{0.8}\text{Fe}_{0.2}\text{OHFeSe}$ is in the crossover regime between elastic Abrikosov vortices to stacks of pancake vortices. Finally, the flux pinning mechanism and vortex phase diagram of both systems are also discussed.

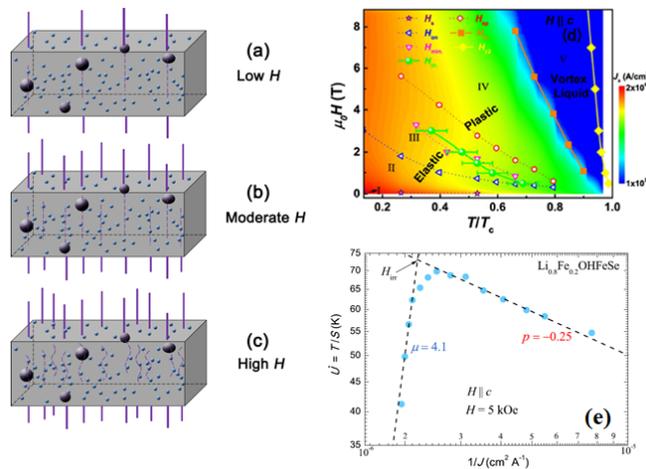


Figure caption: (a)-(c) The schematic diagrams for the vortex configurations under low, moderate, and high field. (d) Vortex phase diagram of $\text{Ca}_{0.8}\text{La}_{0.2}\text{Fe}_{0.978}\text{Co}_{0.022}\text{As}_2$ with various characteristic $H(T)$. (e) Inverse current density dependence of effective pinning energy \bar{U} at 5 kOe in $\text{Li}_{0.8}\text{Fe}_{0.2}\text{OHFeSe}$ single crystal.

References

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