Magnetic Order in S-substituted $FeSe_{1-x}S_x$ Thin Films Grown on $LaAlO_3$ Substrates

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Abstract

Iron-chalcogenide superconductor FeSe does not exhibit a magnetic order but a nematic order at ambient pressure, whereas a magnetic order is induced by hydrostatic pressure [1]. In S-substituted $FeSe_{1-x}S_x$ in which the nematic transition temperature decreases monotonically with increasing x, it has been suggested that spin fluctuations develops around $x = 0.1$ [2]. In our former muon spin relaxation (μSR) measurements on $FeSe_{1-x}S_x$ thin films, it was observed that a short-range magnetic order was formed at low temperatures for $x = 0.3$ and 0.4 [3]. Therefore, to investigate spin fluctuations in the low S-concentration regime where the nematic order is formed, we fabricated $FeSe_{1-x}S_x$ thin films by pulsed laser deposition and performed μSR measurements using low-energy muons at PSI, Switzerland.

For $x = 0.1$, muon spin precession was observed at low temperatures, indicating the formation of a long-range magnetic order. This is likely because enhanced spin fluctuations are stabilized into a magnetic order by lattice strain originating from the substrate. Figure1 shows the S-concentration dependence of the magnetic transition temperature T_m in $FeSe_{1-x}S_x$ thin films. For $x = 0$, a magnetic transition occurs at 80 K, and T_m decreases with increasing x. However, T_m increases for $x \geq 0.2$. This suggests a change in the magnetic state around $x = 0.2$.

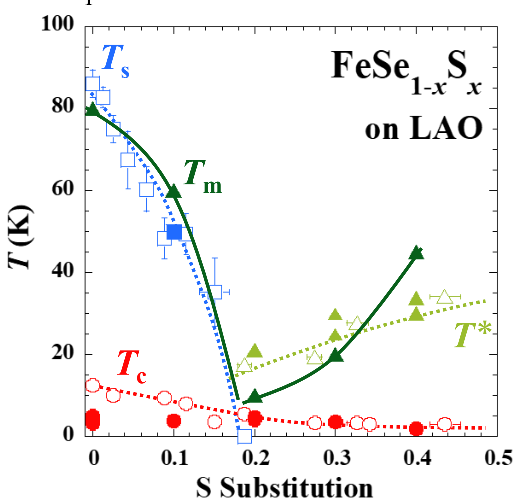

Figure 1 Phase diagram of $FeSe_{1-x}S_x$ thin films. Open symbols represent previous results [4]. T_c denotes the superconducting transition temperature, T_s the nematic transition temperature, T^* the kink temperature in the resistivity, T_m the magnetic transition temperature.

References

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Keywaords: Iron-chalcogenide superconductor, $FeSe_{1-x}S_x$, Thin film, Low-energy muon