

Guiding Principle of Selection of Substrate Material for Iron Chalcogenide Superconducting Thin Films

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In order to grow high-quality iron chalcogenide superconducting thin film, we investigated the effect of substrates on properties of films. Thin films of $\text{FeSe}_{0.5}\text{Te}_{0.5}$ grown on oxide substrates were found to have various structural and transport properties correlated with an occurrence of oxygen penetration from the substrate to the film;¹ The oxygen penetration is suppressed in the higher- T_c films. Because the main driving force of moving oxygen is supposed to be valence change from Fe^{2+} to Fe^{3+} , substrate materials consisting of only typical elements will work better for the growth of iron chalcogenide superconducting thin film. Based on this idea, we applied fluorides. As an initial trial, we grew $\text{FeSe}_{0.5}\text{Te}_{0.5}$ thin films on CaF_2 substrate and obtained film shows the superconducting critical temperature of 15 K with sufficient reproducibility.² This result strongly indicates that using substrate without valence fluctuation can be effective for the improvement of superconducting properties of $\text{FeSe}_{0.5}\text{Te}_{0.5}$ thin films.

¹M. Hanawa, *et al.*, Jpn. J. Appl. Phys. in print.

²I. Tsukada, *et al.*, arXiv: 1104.0477.