Crystal architecture on superconducting layered materials

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High-Tc superconducting materials such Fe-based and cuprates superconductors have a layered structures as shown in fig. 1. In these compounds, superconducting layers and blocking layers are stacked alternately. Many Fe-based superconductors have been found by arranging the blocking layer so far.

11-type iron chalcogenides have the simplest crystal structure among the iron-based superconductors as they are composed of only superconducting layers. However, a small amount of excess iron exists between these superconducting layers, which suppress the superconductivity.

Manipulation of excess iron is required to induce bulk superconductivity in 11 type. We have successfully developed several ways to remove the effect of excess iron from FeSe (one member of 11 type iron-based superconductors) using annealing processes. We have found that oxygen annealing suppress the excess Fe effect and can achieve bulk superconductivity in the 11 system. Alcoholic beverage annealing can also remove excess Fe and induce bulk superconductivity. A further consequence is that the critical current density Jc is also dramatically improved by sulfur annealing.

Further to this, we have recently succeeded in the inducement of superconductivity using an electrochemical reaction similar to that of a Li-ion battery. The excess iron is de-intercalated by an applied electronic current. In my presentation, I will talk in detail about crystal architectonics using electrochemical reaction and the mechanism behind the inducement of superconductivity in iron chalcogenides.

References

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Figures

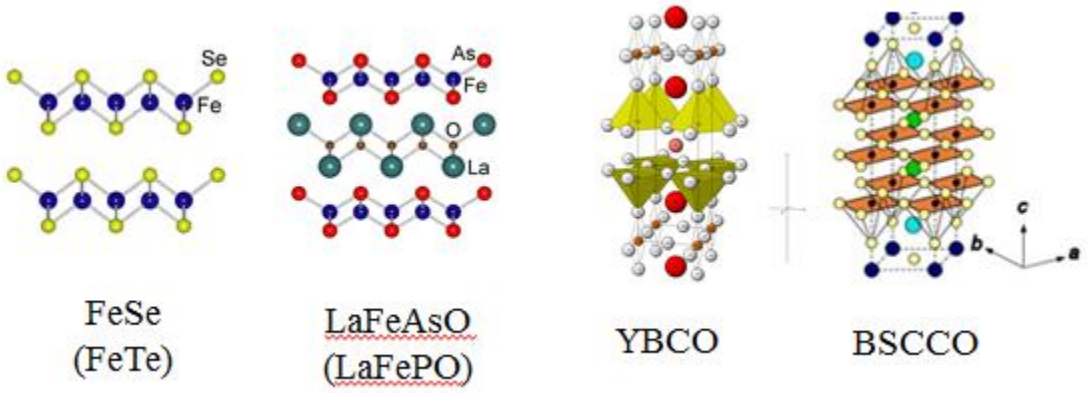

Figure 1. Schematic of crystal strucure of layered superconductos.