Optical spectroscopy of Fe-based ladder compounds

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All the Fe-based superconductors identified so far share a square lattice composed of iron atoms as a common feature. In copper-based high-T_c materials, the superconducting phase emerges not only in square-lattice structures but also in ladder structures, which give nice hints for elucidating the microscopic mechanism of the superconductivity. It is therefore expected to find a novel superconducting phase in Fe-based materials without a square lattice.

We have reported the discovery of the pressure-induced superconductivity in the iron-based ladder material $BaFe_2S_3$ [1,2]. The material is a Mott insulator with the striped-type magnetic ordering below 120 K. On the application of pressure, this compound exhibits a metal–insulator transition at about 11 GPa, followed by the appearance of superconductivity below T_c = 24 K. Stimulated by our discovery, the pressure-induced superconductivity is also found in an isostructural material $BaFe_2Se_3$ [3].

We here show results of reflectivity spectra for a solid-solution $BaFe_2(Se_{1-x}S_x)_3$ in a wide temperature range. We also report on detailed reflectivity measurements under pressure for $BaFe_2S_3$, revealing the pressure-induced dimensional crossover in electronic structure. Our systematic study deepens an understanding on what is the key for the appearance of superconductivity in Fe-based materials.

If time permits, I will briefly discuss future directions of optical spectroscopy under high-magnetic field with a special focus on the possible detection of exotic quasiparticles in magnets.

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