Superconducting transition under long-range ordered antiferromagnetic state in high-T_c cuprates $Ba_2Ca_4Cu_5O_{10}(F,O)_2$: Cu- and F-NMR studies

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In the phase diagrams of high-T_c superconductivity (SC) with doping and temperature, a long-standing problem is the interplay between SC and antiferromagnetism (AFM).
Recently, from Cu- and F-NMR studies, we have observed a SC transition in the background of AFM state in a five-layered high-T_c cuprate $Ba_2Ca_4Cu_5O_{10}(F,O)_2$ [1]. Upon cooling, the internal magnetic field at F sites develops below 175 K, suggesting the long-range AFM ordering with T_N=175 K. On the other hand, the Knight shift K for F-NMR spectra is constant upon cooing from room temperature, but it suddenly decreases below T_c=52 K; this is the evidence of SC transition in the long-range AFM state.
We report systematic Cu- and F-NMR studies on $Ba_2Ca_4Cu_5O_{10}(F,O)_2$ samples with different values of hole density p. Here, p values are controlled by changing the ratio between F^{1-} and O^{2-} at apical sites from underdoped to nearly optimally-doped regions [2]. We will discuss the uniform coexistence of SC and AFM [3], and the layer-number dependence of the AFM-SC phase diagram.

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