Antiferromagnetic order and high temperature superconductivity in underdoped Hg-based Five-layered Cuprates

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We report Cu-NMR study on underdoped Hg-based five-layered cuprates $HgBa_2Ca_4Cu_5O_{12+\delta}$ with T_c=72, 82 and 92 K. From the Knight shift measurements, hole densities at inner planes (IPs) were estimated as 0.053∼0.073 on the basis of the relation of Knight shift and hole density [1]. Zero field NMR measurements reveal that the antiferromagnetic (AFM) moments at IPs are in the range of 0.1∼0.18 μ_B at T=1.5 K for these compounds, which is smaller than 0.5∼0.7 μ_B for undoped Mott insulators. The mobile holes existing at IP uniformly reduce their AFM moments, indicating that a static AFM *metallic* state is realized at underdoped IPs. We also present a phase diagram of CuO_2 plane based on Hg-based five-layered cuprates, which has been revised after the previous reports[2, 3]. It includes the experimental findings such as the existence of AFM metallic state in doped Mott insulators, the uniformly mixed phase of AFM and high-T_c superconductivity, and the emergence of d-wave superconductivity with a maximum of T_c just outside a critical carrier density, at which the AFM moment disappears.

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