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Optical Study of the Pseudogap State in YBa2(Cu1-xZnx)3O7-δ

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It has been shown that the c-axis optical spectra of the high-Tc cuprate superconductors are sensitive to the antinodal region of the Fermi surface that is reflecting the strong effects of the pseudogap. Unlike the other spectroscopic techniques, the optical spectra can in principle distinguish the pseudogap and the superconducting condensation, based on the behavior of the spectral weight transfer. However, in reality, the additional structures such as the transverse Josephson plasma (TJP) mode [1] in the c-axis spectra of the YBa2Cu3O7-δ make the discussion difficult and complicated. In this study, we carried out the temperature dependent c-axis reflectivity measurements on the Zn-substituted YBa2Cu3O7-δ single crystals, where the additional anomalies in the spectra were suppressed with the Zn-doping [2]. In the absence of the TJP resonance mode, we have observed the continuous transfer of the low energy spectral weight to the higher energy region even below Tc as the response of the pseudogap. This is the evidence of the coexistence of the pseudogap and the superconducting gap, suggesting an inhomogeneous state. Furthermore, we found an unexpected Zn-effect, the disappearance of the change in kinetic energy at the superconducting transition which is pronounced in the underdoped regime. This might be due to the weakening of the carrier confinement by Zn-doping [3,4].

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