Light-induced new collective modes in $La_{1.905}Ba_{0.095}CuO_4$ superconductor

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Strong field midinfared pump - terahertz (THz) probe spectroscopy has been proven as a powerful tool for light control of different orders in strongly correlated materials. We present our recent work on the construction of an ulstrafast broadband infrared (ranging from 1.2 μm - 15 μm and beyond) pump - THz probe system in a reflection geometry and its application to the c-axis charge dynamics of a cuprate superconductor $La_{1.905}Ba_{0.095}CuO_4$ with T_c=32 K. Our measurement reveals that the pump-induced change occurs predominantly at the Josephson plasma edge position below T_c. Upon excited by the strong near-infrared pulses, the superconducting state is severely disturbed and incoherent quasiparticle excitations develop in frequency regime above the static plasma edge. However, within very short time delay (roughly about 1.5 ps) we observe the reappearance of a very sharp Josephson plasma edge at frequency lower than the static Josephson plasma edge and a new light-induced edge at higher energy. The results imply that the light can induce new Josephson plasmon modes with different coupling strengths. Similar but weaker effect is observed for the mid-infrared pump. No pump induced effect is detected above T_c.