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Electric-field-induced modulation of the magnetic penetration depth of superconducting $La_{2-x}Sr_xCuO_4$ ultrathin films A. RUEFENACHT, P. MARTINOLI, Institut de Physique, Universite de Neuchatel, J. FOMPEYRINE, D. CAIMI, J.-P. LOCQUET, IBM Research Division, Zurich Research Laboratory — A study of the electric-field-induced change of the in-plane magnetic penetration depth λ_{ab} of an underdoped $La_{2-x}Sr_xCuO_4$ (LSCO) ultrathin superconducting (S) film is reported for the first time. Using MBE, a two unit-cell (UC) thick (x≈0.1) LSCO S-film was grown epitaxially on a 12 UC thick normal (x=0.4) LSCO buffer layer deposited on a monocrystalline. $SrLaAlO_4$ substrate. A capacitor structure was then patterned after growing on top of the S-film a 15 nm thick HfO_2 insulating layer with a dielectric constant ε ≈15 and a Pt gate electrode. The inverse kinetic inductance $1/L_k \propto 1/\lambda_{ab}^2$ of the LSCO film was measured using an inductive two-coil technique. Both the temperature (T) and magnetic-field dependences of $1/L_k$ were investigated by applying gate voltages corresponding to electric fields E = ± (2 x 10^8) V/m. For the largest E-field modulation ($\Delta E \equiv 4$ x 10^8 V/m) a relative change $\Delta L_k^{-1}/L_k^{-1} \approx 18\%$ was observed at low temperature in good agreement with an elementary theoretical estimate. The nonmonotonic T-dependence of $\Delta L_k^{-1}/L_k^{-1}$ (a maximum is observed where $L_k^{-1}(T)$ has the largest slope) can be accurately described by a simple model assuming that $L_k^{-1}(0) \propto T_c$.

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