Abstract

T_c-Variations of $R_{1-y}Ca_yBa_2Cu_3O_x$ under High Pressure: Influence of Doping and Structure

The transition temperature to superconductivity, T_c, of the high-temperature superconductor $R_{1-y}Ca_yBa_2Cu_3O_x$ (R=Y, Nd) can easily be changed by variation of oxygen or calcium content. Exposing the sample to hydrostatic pressure leads to additional T_c changes depending on the oxygen and calcium content. In this work possible origins of the T_c changes under hydrostatic pressure and the role of doping and structural aspects will be discussed.

Like many other superconducting properties the pressure effect dT_c/dp is strongly depending on the hole concentration n_h in the CuO_2 planes. In the underdoped region the pressure effect of $R_{1-y}Ca_yBa_2Cu_3O_x$ is positive and can reach values up to 7 K/GPa. In the optimally doped and overdoped region all $R_{1-y}Ca_yBa_2Cu_3O_x$ systems show the same linear decreasing $dT_c/dp(n_h)$ dependence. For $n_h > 0.175$ the dT_c/dp values are even negative. It will be shown that the $dT_c/dp(n_h)$-dependence with a pressure effect maximum in the underdoped region can be qualitatively described by pressure induced charge transfer from the CuO chains to the CuO_2 planes especially in the underdoped region, however, additional effects besides charge transfer increase T_c under hydrostatic pressure. In the light of the model of pressure induced depinning of spin-charge stripes it becomes clear why non-charge transfer effects lead to large T_c variations under pressure especially in the underdoped regime and why these non-charge transfer effects differ strongly from system to system.