Phonon induced charge modulations and mesoscale pattern formations in high temperature superconductors

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Two recent experimental findings on the formation of stripes in high temperature superconductors (HTSC) show that substantial lattice effects are involved in the onset of stripe formation. Huge phonon anomalies have been observed at finite q-vector where this q-value correlates with doping [1]. In addition a giant isotope effect on the onset temperature T^* for stripe formation has been reported recently [2, 3, 4]. We show here that the striped phase can be caused by strong nonlinear electron-phonon interaction which yields dynamical charge ordering on a mesoscale length scale and in a limited time range. A large isotope effect on T* is obtained together with substantial phonon anomalies. The role played by these dynamic incommensurate patterns for superconductivity is discussed and it is shown that the coexistence of stripes with superconductivity can account for the high transition temperatures observed in copper oxides [5].

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