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Magnetic Phase Separation and its Relation to the Tolerance Factor in Cobaltites JUAN YU, DESPINA LOUCA, University of Virginia, DANIEL PHELAN, KEISUKE TOMIYASU, KAZUMASA HORIGANE , KAZUYOSHI YAMADA — The doping of holes into the non-magnetic Mott insulator, $LaCoO_3$, induces a magnetic inhomogeneous state resulting from competing magnetic phases. Elastic neutron scattering measurements on Ca, Sr, and Ba doped single crystals showed that phase competition is strongly dependent on the tolerance factor, t. When t is small as in $La_{1-x}Ca_xCoO_3$, only a ferromagnetic (FM) phase is present. As t gets large as in $La_{1-x}Ba_xCoO_3$, an incommensurate (IC) phase coexists with the FM phase. The IC phase becomes commensurate and as strong as the FM phase by x = 0.18, with a very long correlation length. This is in stark contrast from $La_{1-x}Sr_xCoO_3$ where the IC phase remains short-range and with its intensity reduced when the system orders ferromagnetically. Our observation shows that increasing t enhances the presence of two phases and favors the growth of nanoscale spin-ordered superstructures. The subtle lattice changes brought about by changing t have a direct effect on the Co-O hybridization that in turn affects the magnetic interactions. Double exchange interactions between Co^{3+} and Co^{4+} result in FM correlations while the superexchange between Co^{3+} ions result in antiferromangetic correlations giving rise to the second phase. This may be mediated by a Jahn-Teller mechanism that sets in at high temperatures.

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