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Ultrafast Polaron Dynamics in Multiferroic $LuFe_2O_4$* R.P. PRASANKUMAR, J. LEE, D. TALBAYEV, A.J. TAYLOR, CINT, Los Alamos National Laboratory, C.L. ZHANG, S.-W. CHEONG, Rutgers Center for Emergent Materials and Department of Physics and Astronomy, Rutgers University, X.S. XU, Department of Chemistry, University of Tennessee — The multiferroic material $LuFe_2O_4$ has attracted much recent attention due to its strong magnetoelectric coupling. We used ultrafast optical spectroscopy to examine $LuFe_2O_4$ by employing a 1.55 eV probe pulse to examine the $Fe^{2+} - > Fe^{3+}$ polaronic excitation as a function of temperature and pump photon energy. After 1.55 eV excitation, the photoinduced reflectivity change $\Delta R/R$ decreases within $\sim$1 picosecond (ps), after which a $\sim$30 ps acoustic phonon oscillation is observed. The initial fast drop in $\Delta R/R$ can be explained by $Fe^{2+} - > Fe^{3+}$ polaron hopping, and the subsequent rapid recovery is due to polaron redressing; this is observed at all temperatures. Pumping the Fe^{2+} on-site excitation at 3.1 eV revealed different dynamics. Notably, coupling between the on-site and charge transfer excitations was strongly suppressed above the antiferromagnetic ordering temperature, demonstrating the strong influence of charge and spin order on polaron dynamics.

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