FEMTOSECOND PUMP-PROBE SPECTROSCOPY OF NEUTRAL Ni AND Cr OXIDE CLUSTERS

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The ultrafast electron dynamics of transition metal oxide clusters provides information about the stability and reactivity of their bulk material counterparts. Nickel and chromium oxides are widely used catalytic materials which may be improved with the detailed atomic precision of their stable conformations and low energy electron properties. In our experiments, neutral Ni_nO_m and Cr_nO_m clusters are produced with small amounts of oxygen and their mass spectra show a primary stable stoichiometry of m = n - 1 for Ni clusters and m = 2n - 2 for Cr clusters. I will present our ultrafast pump-probe spectroscopy measurements on the direct ionization, dissociation, formation, and excitation-relaxation properties for these metal oxide cluster systems extending up to n = 9. Nickel oxides show an increase in the lifetime with the decrease in oxygen content, owing to the change in geometry and increase in relaxation pathways. In contrast, chromium oxides generally show a decreased lifetime with less oxygen atoms from the stoichiometric $(CrO_2)_n$ cluster. In both cluster systems, long-lived lifetimes (over 2 ps) are observed in the suboxide clusters. Overall, it is shown that the ultrafast dynamics observed for these clusters depend strongly on their metal composition, size, and oxidation state.