STABILITY OF NEUTRAL MANGANESE OXIDE CLUSTERS

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Manganese oxides are among the most widely explored transition metal oxides for diverse biomedical applications and are also employed in a wide number of industrial processes. Its wide range of oxidation states provide manganese with extreme flexibility in electron occupancy that has also attracted increasing attention for use in photocatalytic processes. Neutral clusters are excellent mimics of the active sites of bulk materials, and can be employed to understand the local geometric and electronic structure properties, and oxidation states that provide the best charge carrier lifetimes and by extension optimal photochemical efficiency. Here, I will present our ongoing work on the ultrafast relaxation dynamics of neutral manganese oxide clusters, which are prepared through the laser ablation of a pure metal rod with a 532 nm Nd:YAG laser. A synchronized pulse of He seeded with 5% oxygen enables cluster formation through supersonic expansion. The neutral clusters are then studied through by combining two-color femtosecond spectroscopy with time-of-flight mass spectrometry. Our cluster distribution shows that manganese has a large range of oxidation states. The clusters are excited by the second harmonic of a Ti:Sapphire femtosecond (fs) laser system (400 nm = 3.1eV) and subsequently ionized through strong field ionization with the fundamental laser beam (800 nm = 1.55 eV). The subtle changes in the ultrafast dynamics upon the addition/subtraction of each atom are being evaluated to provide new understanding to the flow of energy through a material.