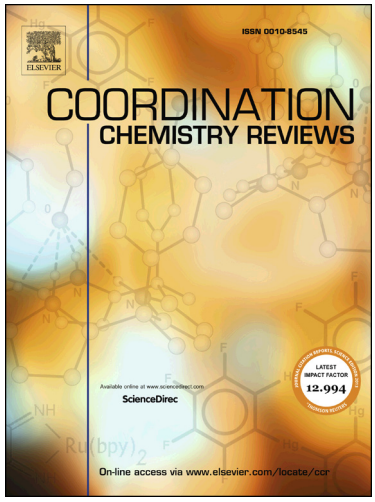

Matrix Preparation and Spectroscopic and Theoretical Investigation of Small High Oxidation-State Complexes of Groups 3-12, 14, Lanthanide and Actinide Metal Atoms: Carbon-Metal Single, Double and Triple Bonds

Han-Gook Cho, Lester Andrews

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Matrix Preparation and Spectroscopic and Theoretical Investigation of Small High Oxidation-State Complexes of Groups 3-12, 14, Lanthanide and Actinide Metal Atoms: Carbon-Metal Single, Double and Triple Bonds.

Han-Gook Cho[a] and Lester Andrews*[b]

[a] Department of Chemistry, Incheon National University, 119 Academy-ro, Yeonsu-gu, Incheon, 22012, (South Korea) [b]Department of Chemistry, University of Virginia, P. O. Box 400319, Charlottesville, Virginia 22904-4319 (USA),

Abstract: Our first review article in 2006 outlined the observation, photochemical properties, and theoretical investigations of a new breed of small transition-metal complexes with C-M multiple bonds generated from reactions of group 4-6 metals with methane and methyl halides. Since then, numerous small high oxidation-state complexes have been provided by reactions of laser ablated group 3-12 transition metal, group 14 silicon atoms and lanthanide and actinide atoms with small organic precursors. Periodic trends in the primary products and their molecular structures and photochemistry are apparent. While no methylidyne reaction products were detected in reactions of the elements on the left and right sides of the d-block in the periodic table, they were the sole products in reactions of Re and Os. The actinide products identified are comparable to those from early transition-metal reactions. Agostic distorted molecular structures, photo-reversible conversions, vibrational frequencies, intensities and reaction paths have been theoretically investigated. These recent results show that C-H or C-X bond insertion and subsequent H or X migration to form higher oxidation-state products are a general phenomenon