

## SPECTROSCOPIC STUDIES OF $\pi$ -BACKDONATING EARLY TRANSITION METAL AND MONOVALENT LANTHANIDE DIBORIDES

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The second period p-block elements reign as mainstays in a plethora of scientific disciplines due to their varied chemical bonding and significant natural abundance. Indeed, the range of chemistries of these p-block elements is profoundly expanded when these atoms, particularly electron deficient boron, bond with transition metals and lanthanides. Exotic metallaboron compounds have been demonstrated to participate in a wide array of bonding schemes, mechanisms, and geometries. Here, resonant two-photon ionization spectroscopy and *ab initio* quantum chemical calculations are used to elucidate the chemical bonding and electronic structure of triatomic metal diboride complexes. These previously unstudied species are demonstrated to require an extension of the Dewar-Chatt-Duncanson bonding model of organometallic chemistry. Instead of weakening the bond in the diboron ligand via backdonation into the  $\pi^*$  antibonding orbital, the metal-boron and boron-boron bonds are strengthened by backdonation into the  $\pi$  bonding orbital of diboron. Moreover, it is shown that the lanthanide atoms in these species exhibit a rare +1 oxidation state, further defining this family of molecules as a special class of monovalent lanthanide compounds.