Professor Chirik’s research group is exploring “modern alchemy” for sustainable chemistry – a concept defined as using ligand design to transmute the function of an earth abundant metal to mimic or ideally surpass the performance of more exotic precious elements. At the core of his work is understanding and manipulating electron flow in first row transition metal compounds. His research group integrates modern spectroscopic and theoretical methods to accomplish these objectives. In one limit, oxidation and reduction chemistry occurs cooperatively between the metal and the supporting ligand. This concept of “reduced active” ligands has resulted in new base metal catalysts for the asymmetric hydrogenation of alkenes as well as more traditionally employed precious metals that are some of the least available elements in the Earth’s crust. Use of these elements extends beyond potential cost advantages; reduced carbon dioxide production and stability of supply chains are also potential benefits. Ultimately we aim to discover new reactivity that exploits the unique electronic structures of first row transition metals. Earth abundant catalysts for commercial silicone production,\(^1\) asymmetric alkene hydrogenation,\(^2\) C-H functionalization\(^3\) radiolabeling of pharmaceuticals\(^4\) and alkene cycloaddition\(^5\) have been reported. My lecture will focus on the application of first row transition metal catalysts to the discovery of new catalytic reactions for the synthesis of carbon-boron bonds, some of the most valuable linkages in organic methodology. New strategies for isomerization-hydroboration will be discussed as will new routes to enantiopure diboron compounds enabled by cobalt-catalyzed asymmetric hydrogenation. Methods for cobalt catalyzed C-H borylation will also be presented that offer distinct advantages in selectivity over known precious metal routes will also be presented. The origin of the unique reactivity and the role of the electronic structure of the earth abundant metal will be highlighted throughout.