

What Difference Does One Electron Make? Quantum Chemistry of Boron, Carbon and Nitrogen Polyhedral Compounds

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We consider polyhedral chemical compounds derived from the elements of the Periodic Table Boron, Carbon and Nitrogen and their electronic structure: Why does Boron have such rich architectural molecular constructs as compared to Nitrogen? There is only a difference of one electron between Boron and Nitrogen when compared to Carbon: An electron LESS or an electron MORE makes such a big difference in the chemistry of their compounds! Clusterization of boron compounds – polyhedral (metala)heteroboranes – is due to the need of satisfying (quantum) valencies when combined, namely, a chemical bond, but having less electrons than carbon; hence clusterization occurs, such as in the icosahedral dianion $B_{12}H_{12}^{2-}$ (see Figure). The case of Nitrogen is striking, since it does not form any type of (stable) polyhedral compound similar to Carbon or Boron derivatives. Chains and rings of nitrogen rich compounds have been previously analyzed.

