

Answer on Question #53496 – Chemistry – Inorganic Chemistry

Question:

how can nitrogen show large number of oxidation state i.e from -3 to +5.explain with example.

Answer:

Available oxidation state is determined by electronic configuration of element. Considering the nitrogen atom it has 5 valence electrons:



Large number of oxidation state is provided by the using four orbitals (one 's' and three 'p') which can contain from 0 to 8 electrons. Therefore oxidation state varies from +5 to -3. These limits are represented by the most energetically favorable configurations of nitrogen:

- 1) '-3' corresponds to completed quantum level which contains 8 electrons ($1s^2 2s^2 2p^6$)
- 2) '+5' belongs to the configuration with empty outer quantum level ($1s^2 2s^0 2p^0$).

Nitrogen can attach 3 electrons to complete the quantum level to form configuration: $\text{N}^{3-}: 1s^2 2s^2 2p^6$

It occurs with elements which has lower electronegativity than nitrogen.

For instance: NH_3 , Li_3N

Also it forms with hydrogen less stable compounds having oxidation states are of -2 and -1, respectively.

Their configurations are $\text{N}^{2-}: 1s^2 2s^2 2p^5$ and $\text{N}^{-1}: 1s^2 2s^2 2p^4$, which are represented by N_2H_4 (hydrazine) and NH_2OH (hydroxylamine), respectively.

Zero oxidation state has configuration $\text{N}^0: 1s^2 2s^2 2p^3$ and can be found in molecule of N_2 .

Two oxides with oxidation states of +1 ($\text{N}^{+1}: 1s^2 2s^2 2p^2$) and +2 ($\text{N}^{+2}: 1s^2 2s^2 2p^1$) also exist: N_2O and NO , respectively.

Interaction of Nitrogen with elements having higher electronegativity leads to lose of 3, 4, 5 electrons. This gives the following electronic configurations:

$\text{N}^{3+}: 1s^2 2s^2 2p^0$ Represented by NF_3 , N_2O_3

$\text{N}^{4+}: 1s^2 2s^1 2p^0$ Found in NO_2

$\text{N}^{5+}: 1s^2 2s^0 2p^0$ For instance, HNO_3 , N_2O_5 .