Trinity Hamilton
Chem 515
Exploring Electron Transfer in the Mo-dependent Nitrogenase

The metalloenzyme nitrogenase is utilized by microbial diazotrophs to accomplish the majority of biological nitrogen fixation. Many different forms of the enzyme nitrogenase are known to exist. They are categorized by the type of metal cluster providing the N\(_2\)-binding site, which is also the active site of the enzyme. The nitrogenase best-characterized to date has an active site with the composition [7Fe-9S-1Mo-X-homocitrate], owing to its designation as a MoFe-cofactor. The protein containing the active site also houses a P-cluster ([8Fe-7S]) necessary for electron transfer. A smaller, MgATP-dependent, Fe protein with a [4Fe-4S] cluster functions to deliver electrons to the active site.

A variety of structural and functional studies have shed light on the mechanism of N\(_2\) reduction by nitrogenase via the MoFe protein and the Fe protein. The following will provide evidence for electron transfer between the metal clusters through chemical and structural analysis of both the metal clusters and their substrates. Electron paramagnetic resonance spectra, density functional theory, and X-ray scattering studies are just a few of the techniques utilized in the elucidation of the Mo-dependent nitrogenase. A discussion of these techniques and their role in the characterization of this metalloenzyme will reveal the current understanding of the metal clusters and their part in N\(_2\) reduction.