Metal oxos in chemistry and biology

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Abstract:
The dianionic oxo ligand occupies a very special place in coordination chemistry, owing to its ability to donate pi electrons to stabilize high oxidation states of metals. The ligand field theory of multiple bonding in metal-oxos predicts that there must be an “oxo wall” between Fe-Ru-Os and Co-Rh-Ir in the periodic table. There have been many attempts to break down the wall, but in my seminar I will report that it is still standing! I will discuss the roles metal-oxos play in two of the most important chemical reactions on planet Earth, water oxidation to oxygen in photosystem II, and hydrocarbon oxygenation catalyzed by cytochrome P450.

Global Impact: Fuel, Materials, Food

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\begin{align*}
\{ \text{H}_2\text{O}, \text{CH}_4, \text{CO}_2, \text{N}_2 \} & \text{ + solar energy} & \text{hydrogen, methanol, ethylene fuels/materials, ammonia/amines} \\
\end{align*}
\]

Cathode Half-Reactions
\[
\begin{align*}
2\text{H}^+ + 2\text{e}^- & \rightarrow \text{H}_2 \\
\text{N}_2 + 6\text{H}^+ + 6\text{e}^- & \rightarrow 2\text{NH}_3 \\
\end{align*}
\]

Anode Half-Reactions
\[
\begin{align*}
2\text{H}_2\text{O} & \rightarrow 4\text{e}^- + 4\text{H}^+ + \text{O}_2 \\
\text{CH}_4 + \text{H}_2\text{O} & \rightarrow 2\text{e}^- + 2\text{H}^+ + \text{CH}_3\text{OH} \\
\end{align*}
\]