**The ditungsten tetracarboxylate story (Sattelberger)**

This LO is part of a special VIPEr collection honoring the 2022 ACS National Award recipients in the field of inorganic chemistry. Alfred P. Sattelberger was the recipient of the 2022 ACS Award for Distinguished Service in the Advancement of Inorganic Chemistry.

Santure, D.J.; McLaughlin, K.W.; Huffman, J.C.; Sattelberger, A.P. “Metal-Metal-Bonded Complexes of the Early Transition Metals. 7. The Ditungsten Tetracarboxylate Story” *Inorg. Chem.*, **1983**, *22*, 1877-1883.

**Metal-metal quadruple bonds**

Molybdenum complexes containing a Mo-Mo quadruple bond have been known since at least the early 1960’s. Bridged carboxylate dimers with an Mo24+ core are the most important class of these molecules. The quadruple bond is formed by the overlap of molybdenum’s d-orbitals.

1. Draw and label an orbital sketch of each of the four metal-metal bonds.
2. Comment on the relative strength of the delta bond. Why might it be stronger or weaker than the other bonds?
3. In a 1983 *Inorganic Chemistry* paper, Sattelberger and coworkers report the first tungsten analogs of these molybdenum compounds. This was more than 20 years after the first molybdenum dimers were reported and after many chemists had tried to make them and failed. The tungsten compounds are very sensitive to oxidation relative to the molybdenum compounds. They require an acid-free synthesis and careful exclusion of air.

What *experimental evidence* do the authors use to support the existence of the W-W quadruple bond in their complexes? You should provide at least two examples.

**Synthesis of W2(TFA)4**

1. Reaction 3 in the paper describes the author’s preferred route to the desired tungsten dimer. Write out the reaction and explain what is happening using words and oxidation states/numbers.

[WCl4]x + 2NaTFA + 2Na/Hg → 0.5 W2(TFA)4 + 4NaCl

**Electron counting**

1. Using the CBC electron counting method, count the electrons in the parent tungsten dimer, W2(TFA)4.

**Structure of W2(TFA)4**

1. The authors were able to isolate good crystals and obtain crystal structures of two adducts of the W2(TFA)4 parent complex: W­2(TFA)4ᐧ2/3digly and 2.242(2)Å W2(TFA)4ᐧ2PPh3.

The tungsten complexes are described as having “idealized D4h symmetry with the tungsten atoms bridged by trifluoroacetate ligands.”

1. Sketch the molecule *looking down the W-W bond axis* in order to show the D4h symmetry. This is similar to a Newman projection that you might have learned about in organic chemistry.
2. Indicate all of the D4h symmetry elements in your sketch.