**Zinc-Zinc Bonds**

**Literature Reading Assignment**

*Read the following article before class:*

Irene Resa, Ernesto Carmona, Enrique Gutierrez-Puebla, and Angeles Monge, “Decamethyldizincocene, a Stable Compound of Zn(I) with a Zn–Zn Bond,” *Science* **2004**, *305*, 1136 – 1138.

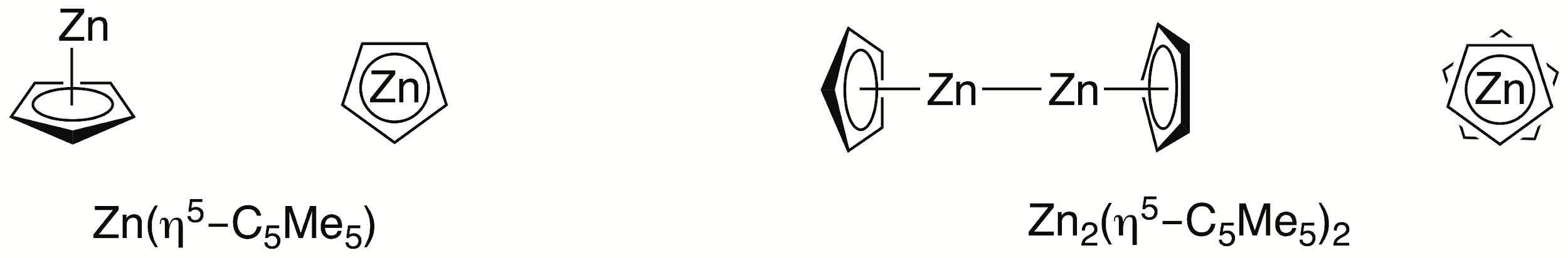
Gerard Parkin, Zinc-Zinc Bonds: A New Frontier *Science* **2004**, *305*, 1117 – 1118.

*To prepare for discussion, work the following problems to turn in:*

1. The structure of the starting material bis(pentamethylcyclopentadienyl)zinc, (C5Me5)2Zn, has been described as an “open-faced” sandwich structure, consisting of one η5-Cp\* ring and one η1-Cp\* ring rather than a “regular” sandwich structure composed of two η5-Cp\* rings.
   1. Rationalize the “open-faced” sandwich structure for (C5Me5)2Zn based on electron counting formalisms.
   2. How many peaks would you expect to see in the 1H NMR of the starting material, (C5Me5)2Zn? If only one singlet is observed, how might you interpret this? How could changing the temperature when running the NMR help you confirm your suspicions?
2. The authors explain that when compound **1** is reacted with water, a disproportionation reaction occurs.
   1. Write a balanced reaction equation for the reaction of **1** with water.
   2. Assign the oxidation state of zinc in the reactants and products of this reaction.
   3. Based on the oxidation states in part a, which compound is being oxidized and which is being reduced?
   4. Based on your answer to part b, what is the definition of a disproportionation reaction?
3. In both the article and the companion *Perspective* piece, the zinc-zinc distance is compared to Cd-Cd and Hg-Hg distances in compounds understood to have metal-metal bonds and to the metallic radii of the elements.
   1. Explain in detail the argument the authors use to rationalize there is a zinc-zinc bond in this compound.
   2. Explain why there is a fairly large increase in metal-metal bond distances and in the metallic radii in going from zinc to cadmium, but very little change in going from cadmium to mercury.
4. Describe the evidence that rules out bridging hydride ligands in this molecule.
5. Use SciFinder to locate another paper with a Zn+ (Zn(I)) oxidation state and another paper with a Zn-Zn metallic bond. Provide your answers as ACS style references.
6. Provide an electron count for the product, compound 1.
7. What is the point group of the starting material Zn(η5-C5Me5)(η1-C5Me5) and compounds 1, 2, and 3?
8. Justify the lack of color reported for compound 1.
9. Explain why two Zn(0) atoms cannot form a metal-metal bond.
10. Zn2(η5-C5Me5)2 can be described as a dimer between two Zn(η5-C5Me5)fragments (below, methyl groups excluded for clarity). For the fragment and the molecule:
    1. Draw all symmetry elements.

b. Assign the point group.

c. Count electrons.



*Additional Question:*

* After reading Resa’s paper, describe in your own words the contributions to the field that warranted this being published.
* What might be the organic by-products of the reaction in figure 1? What analytical technique would allow one to determine organic by-products?