Catalysis is a kinetic phenomenon, how quickly can we get to a product. It by no means indicates stability or the most thermodynamically favored product. Consider the reaction below, *ortho*-carborane is a kinetic product and the *para*-carborane is a thermodynamic product while ionic liquids is a catalyst.

1. Explain the difference between a kinetic and a thermodynamic product.

The important part of the cycle is that the catalyst has significant turn-over (many equivalents of product before it slows down or stops working). One turn over is equivalent to one trip around the cycle.

Consider the catalytic cycle for the Heck reaction shown below.
2. Using the template below, write in the names of the reactions at each step in the “blank” cycle provided.

Hydrosilylation (the addition of $R_3SiH$ to a double bond) is an important reaction in the silicone polymer industry. It is used for “curing” silicone rubber, by cross-linking polymer chains. The reaction is catalyzed by Pt and Rh complexes following the cycle shown.

3. Complete the catalytic cycle by filling in the names of the steps and the missing intermediate.

4. What is the oxidation state of the Pt in each of these catalytic steps?

5. Thinking question: The hydrosilylation of 1-hexene was carried out in two different experiments: one with Me$_3$SiH and the other with Me$_3$SiD. The relative reaction rate ratio was 5.4:1. Based on this information, which step in the cycle is rate-determining? Explain.

Exercise \(\PageIndex{1}\)

Using your textbook or other reliable source, outline the catalytic process involved in the manufacture of acetic acid (Monsanto process) and acetic anhydride (Tennessee-Eastman process).
Reference

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