**Building hybrid nanoparticles**

This in-class activity was created at the NSF-sponsored cCWCS VIPEr workshop at Penn State, June 2013. It is based on the article from Ray Schaak’s group (Buck, Matthew R.; Bondi, James F.; Schaak, Raymond E. “A total-synthesis framework for the construction of high-order colloidal hybrid nanoparticles” *Nature Chemistry* **2012**, *4*, 37-44, DOI: 10.1038/NCHEM.1195), which Ray presented at the workshop.

Work with the other students in your team to answer the following questions.

1. The researchers first synthesized nanoparticles of Pt and then used them as seeds to grow Fe3O4 particles. The resulting Pt-Fe3O4 particles contained two domains:



If these Pt-Fe3O4 dimer nanoparticles are put in an environment that encourages the growth of Ag nanoparticles, where are the possible nucleation sites for Ag? Draw pictures for all of the possible configurations.

2. How would you chemically rationalize each of these configurations? Which do you predict is the most likely, if any?

3. Design a series of control experiments that would help to explore the binding of Ag to the Pt-Fe3O4 hybrid nanoparticles. How could you prove whether Ag nucleates on Pt and Fe3O4 separately?

4. Suggest experimental techniques that could be used to distinguish between the possible products.

5. The product obtained when depositing nanosilver onto the nano Pt–Fe3O4 is exclusively Ag–Pt–Fe3O4. Suggest a reason.