

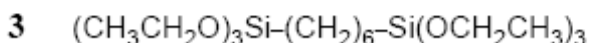
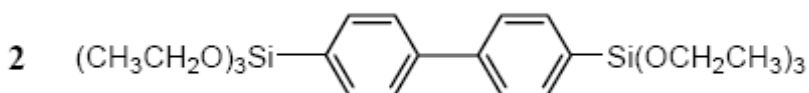
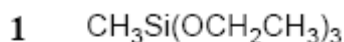
Chem 584
Introduction to Materials Chemistry
Homework #5

Due at the beginning of lecture, Monday, Oct. 20
(Show work)

For the following questions feel free to use outside sources, but please site the sources that you use.

1) How thin is a thin film, and why does it deserve its own nomenclature (i.e. what is special about thin film materials)?

2) The following three molecules will all react with excess water under acidic conditions in ethanol solution:



a) Using your knowledge of sol-gel processing, explain the following observation in terms of the reaction mechanism of sol-gel polymerization: Hydrolysis of **2** and **3** yields clear gels, but hydrolysis of **1** does not yield a clear gel, even though high molecular weight species are formed in solution. Note that none of the three reactions yields a precipitate: the gels obtained from **2** and **3** are clear and transparent as is the polymer obtained from **1**.

b) The xerogel obtained from **2** has large pores and a higher surface area than the xerogel obtained from **3**. Provide an explanation for this observation.

3. Read the following article to answer these questions:

Zhang, P.; Xu, F.; Navrotsky, A.; Lee, J. S.; Kim, S.; Liu, J. Surface Enthalpies of Nanophase ZnO with Different Morphologies. *Chem. Mater.* **2007**, 19, 5687-5693

<http://pubs.acs.org/cgi-bin/asap.cgi/cmatex/asap/pdf/cm0711919.pdf>

- a. Sketch the wurtzite structure.
- b. Identify the (0001), (10 $\bar{1}$ 0), planes.
- c. Which of these planes is more stable based on planar densities?
- d. Explain why nanorod growth occurs along the (0001) axis.
- e. Why did the ZnO nanoparticles have a lower surface energy than the nanorods/tetrapods?

4. Read the following article to answer these questions:

Tang, B.; Yang, F.; Lin, Y.; Zhuo, L.; Ge, J.; Cao, L. Synthesis and Characterization of Wavelength-Tunable, Water-Soluble, and Near-Infrared-Emitting CdHgTe Nanorods, *Chem. Mater.* **2007**, 19, 1212-1214

<http://pubs.acs.org/cgi-bin/article.cgi/cmatex/2007/19/i06/html/cm062805x.html>

- a. What band gaps do a near infrared emission (800-2500nm) correspond to?
- b. What was the role of cysteine and thioglycolic acid the synthesis of CdTe nanorods?
- c. Suggest a cause for the red shift of the photoluminescence spectrum due to the Hg²⁺ addition to CdTe nanorods.