Final Exam – Inorganic Materials Chemistry - Fall 2001 **name: ……**

100 points

1. (10 points) α- Fe has a bcc structure at normal conditions. In the Earth core (Ni-Fe) the pressure reaches above 3 Mbar and temperature up to 4500 °C. What crystal structure would you expect for Fe under these conditions. Show your reasoning and draw corresponding unit cells.

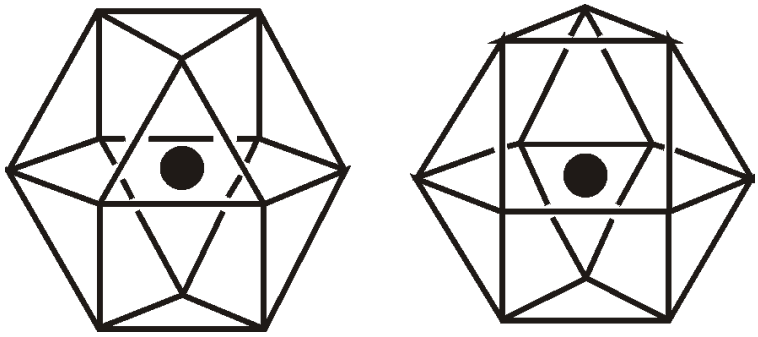
2. (10 points) List major categories of materials grouped according to their interaction with microwave radiation and give specific examples for each category.

3. (10 points) Give a brief explanation the following terms:
nanoparticle, mesopore, template, adatom, flux, cavitation, mineralizer, micelle, self-assembled monolayer, single-source precursor.

4. (40 points) Explain in some detail principles of **four** of the following six methods and give specific examples of reactions.
1) Self-propagating high-temperature synthesis (SHS)
2) Mechanochemical synthesis
3) Chemical vapor deposition (CVD)
4) Vapor phase transport (VPT)
5) Precursor methods
6) Shape selective catalysis

5. (10 points) Which of these polyhedra represents the coordination environment of a metal atom (black ball) in:

a) copper, ccp
b) magnesium, hcp



6. (20 points) A solid state reaction between Ni and $NiBi_3$ discs leads to the product shown below. Consider three cases:
a) only Ni diffuses through the interfaces
b) only Bi diffuses through the interfaces
c) both Ni and Bi diffuse through the interfaces at the same rate
Calculate for each case the Kirkendall ratio, compare your results with Figure 5, and suggest which mechanism is the most plausible.

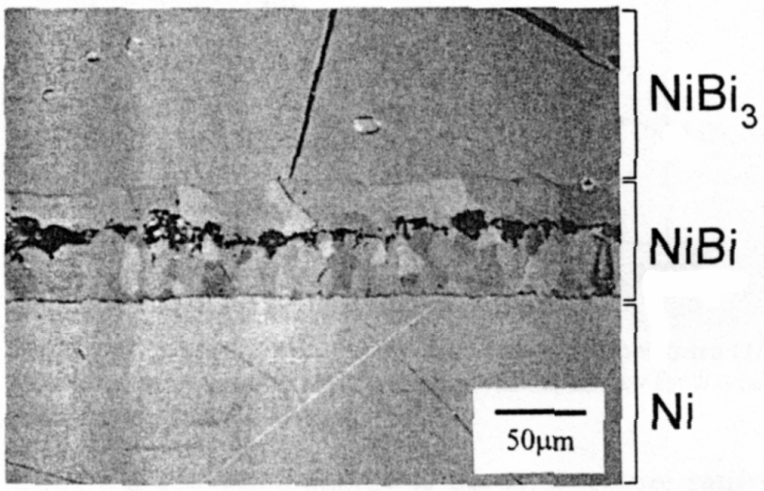


Figure 5. A cross sectional picture (polarized) showing the reaction product NiBi for the reaction between $NiBi_3$ and Ni at 370 °C for 600 h. From top to bottom, the three layers are $NiBi_3$, NiBi, and Ni, respectively. The crack within NiBi delineates the original interface between Ni and $NiBi_3$ before the reaction.