Materials 286G, Special Topics: Structural families of functional inorganic materials

Catalog Description:
In this advanced inorganic materials course, we will learn how different crystal structural classes of materials are inter-related, and how properties evolve as a consequence of the different structural families.

Teaching frequency:
Every alternate academic year, Spring.

Target audience:
Graduate students who have taken Materials 218 or equivalent.

Textbooks:
Current literature

Instructor:
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Course Website:
http://www.mrl.ucsb.edu/~seshadri/teach.html

Outline (no guarantees):
1. Background on structures, rules, bond valence . . .
2. Rock-salt, zinc blende, Half-Heusler and Heusler phases, and ferromagnetism.
3. Semiconductors: Wurtzite, zinc blende, chalcopyrite
4. Fluorite, pyrochlore, and structural materials
5. Spinel, pyrochlore, and magnetic frustration
6. Ice-$I_h$, the Bernal-Fowler rules, and zero-point entropy
7. Spinel, garnet, magnetoplumbite, and ferrimagnetism
8. The Verweij transition in Fe$_3$O$_4$ and LiMn$_2$O$_4$; charge ordering
10. Perovskite, Ruddlesden-Popper phases, and insulator-metal transitions
11. Perovskite, Ruddlesden-Popper phases, and high $T_C$ superconductivity
12. Perovskite, Aurivillius phases, and ferroelectricity
13. Perovskites, shear phases, TTB, HTB, and electrochromic materials
14. PbO (litharge), vernier, chimney-ladder and misfit phases, and incommensuration
15. Frank-Kasper and Laves phases, topological close packing, and quasicrystals
16. High coordination, complex potential energy landscapes, and metallic glasses
17. Zintl thermoelectrics
18. Layered compounds and Li-ion batteries
19. Other topics by request from students