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, Fall or 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_3O_4 and $LiMn_2O_4$; charge ordering
9. Chalcogenide spinels and the effects of covalency: ferromagnetic semiconductors.
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