

# From Bonds to Bands: Chemistry and Physics of Solids

Instructor: Prof. Fazel Tafti, Higgins 330A, [fazel.tafti@bc.edu](mailto:fazel.tafti@bc.edu)

Lectures: Tuesdays and Thursdays, 10:30 am, Higgins 275

Office hours: Tuesdays 4-6 pm, Higgins 330A

Prerequisites: All senior students and graduate students from physics and chemistry department can take this course.

Contents: From a free electron to an electron in a potential well to an electron bound in an atom, From plane waves to atomic orbitals, From atomic orbitals to molecular orbitals (symmetries, point group theory, and molecular orbital theory), From ionic bonds to covalent bonds to metallic bonds, From bonds to bands (augmented plane waves, wannier functions, tight binding model), From point groups to space groups (glide planes and screw axes), From space groups to solids (a survey on the common structure types), From real space to momentum space (lattice momentum versus real momentum), From static lattice to dynamic lattice (phonons, theory of heat capacity), From localized to delocalized electrons (conduction electrons, Fermiology, Boltzmann theory of transport), From theory to experiments (material synthesis and crystal growth techniques), From melt to crystallization (growth out of melt, interpreting binary phase diagrams), From material synthesis to material science (XRD, SEM, EDS, TEM, XPS)

References:

1. Handouts will be provided
2. Inorganic chemistry by Miessler and Tarr
3. Solid state physics by Ashcroft and Mermin

Evaluation: 40% homework, 60% projects