Solid State Chemistry
CHEM-E4155 (5 cr)

Spring 2021

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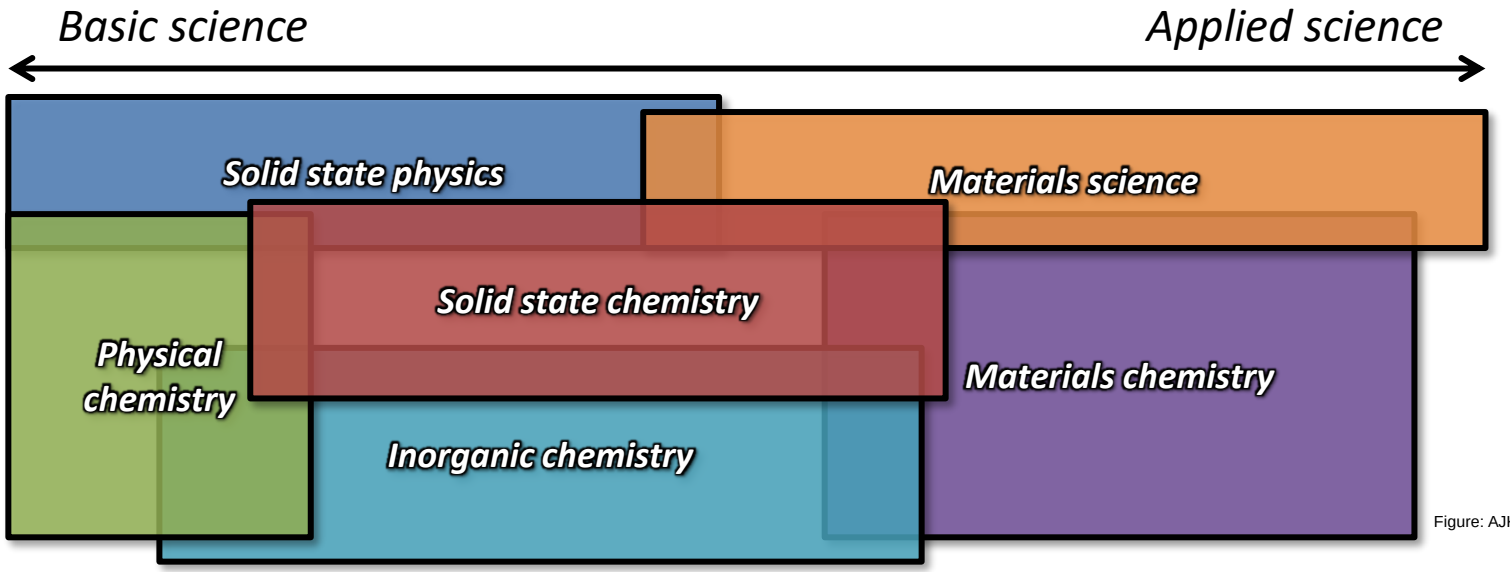
Solid state chemistry

- Synthesis, structures, properties, and applications of crystalline inorganic materials



- ***Atomic-level structure*** of materials is at the very heart of solid state chemistry
- *"If you want to understand function, study structure"*
  - ***Francis Crick*** (1962 Nobel Prize in Physiology or Medicine – Structure of DNA)
- The above classification is a rather traditional one: relatively new concepts such as ***metal-organic frameworks*** bring organic/organometallic chemistry into the picture
- What is ***your*** background? Chemistry, materials science, something else?

Course outline

- **Teacher:** Antti Karttunen
- **Lectures**
  - 14 lectures (course calendar shown on a later slide)
  - Each lecture includes a set of exercises (a MyCourses Quiz)
  - We start the exercises together during the lecture
- **Project work**
  - We create content in the Aalto Solid State Chemistry Wiki
  - Includes both independent and collaborative work (peer review)
  - Lots of content has been created in the Wiki since 2017.
- **Grading**
  - Exercises 50%
  - Project work 50%
- **Workload (135 h)**
  - Lectures, combined with exercises ~28 h
  - Home problem solving ~28 h
  - Independent project work ~40 h

Honor code for exercises

- The purpose of the exercises is to **support your learning**
- Most of the exercises are graded automatically
  - There may also be some manually graded exercises
- It is perfectly OK to discuss the exercises with the other students
  - In fact, I encourage discussion during the exercise sessions
- It is **not OK** to take answers directly from the other students
  - This also means that is **not OK** to give answers directly to the other students
- The exercise answers and timestamps are being monitored

Course calendar

Lectures in Zoom (https://aalto.zoom.us/j/69449935597) at 10:15-12:00

Week	Lect.	Date	Topic
Week 1	1	Mon 11.1.	Structure of crystalline materials. Symmetry.
Structure	2	Wed 13.1.	Structural databases, visualization of crystal structures.
Week 2	3	Mon 18.1.	Bonding in solids. Description of crystal structures.
Bonding	4	Wed 20.1.	Band theory. Band structures.
Week 3	5	Mon 25.1.	Phase diagrams, crystal growth.
Synthesis	6	Wed 27.1.	Solid state synthesis.
Week 4	7	Mon 1.2.	XRD, Miller indices. Powder XRD databases. Microscopies.
Characterization	8	Wed 3.2.	Spectroscopies and thermal analysis.
Week 5	9	Mon 8.2.	Abundance of elements, geochemistry, minerals.
Main groups	10	Wed 10.2.	Main group compounds, allotropes, Zintl phases.
Week 6	11	Mon 15.2.	*d*-block metals, ligand field theory, magnetism.
d-block metals	12	Wed 17.2.	*d*-block metal oxides and other compounds.
Week 7	13	Mon 1.3.	At **14-16.** Defects, non-stoichiometric compounds.
Defects and doping	14	Wed 3.3.	At **12-14.** Semiconductors, doping, electrical properties.

Literature for the course

- *Solid State Chemistry and its Applications* – Student Edition (2nd ed.), Anthony R. West, **2013**, Wiley.
- *Inorganic Structural Chemistry* (2nd ed.), Ulrich Müller, **2006**, Wiley
  - (*Anorganische Strukturchemie* (fünfte Ed.), **2006**, Wiley)