Solid State Chemistry
CHEM-E4155 (5 cr)

Spring 2022

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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 classification illustrated below is a rather traditional one: concepts such as ***metal-organic frameworks*** bring organic/organometallic chemistry into the picture
- What is ***your*** background? Chemistry, materials science, something else?

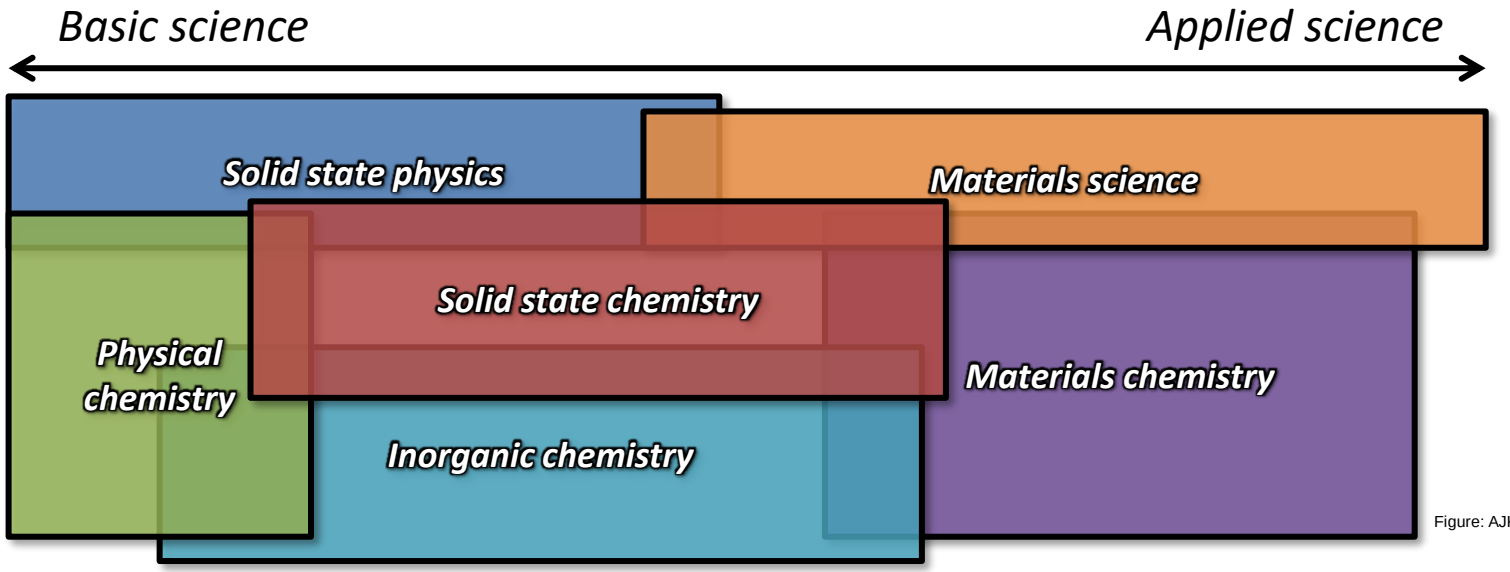

Figure: AJK

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.
  - New in 2022: Zulip workspace for discussions and questions about exercises.
- **Project work**
  - We create content in the Aalto Solid State Chemistry Wiki
  - Includes both independent and collaborative work (peer review)
- **Grading**
  - Exercises 50% and Project work 50%
- **Workload**
  - 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 fine to discuss the exercises with the other students
  - In fact, I encourage discussion during the teaching sessions
- You are **not allowed** to take answers directly from other students
  - This also means that you are **not allowed** to give answers directly to others
- The exercise answers and timestamps are monitored throughout the course

Course calendar

Lectures in Zoom (https://aalto.zoom.us/j/65165606246) at 8:30-10:00

Week	Lect.	Date	Topic
Week 1	1	Wed 12.1.	Structure of crystalline materials. Symmetry.
Structure	2	Thu 13.1.	Structural databases, visualization of crystal structures.
Week 2	3	Wed 19.1.	Bonding in solids. Description of crystal structures.
Bonding	4	Thu 20.1.	Band theory. Band structures.
Week 3	5	Wed 26.1.	Phase diagrams, crystal growth.
Synthesis	6	Thu 27.1.	Solid state synthesis.
Week 4	7	Wed 2.2.	XRD, Miller indices. Powder XRD databases. Microscopies.
Characterization	8	Thu 3.2.	Spectroscopies and thermal analysis.
Week 5	9	Wed 9.2.	Abundance of elements, geochemistry, minerals.
Main groups	10	Thu 10.2.	Main group compounds, allotropes, Zintl phases.
Week 6	11	Wed 16.2.	*d*-block metals, ligand field theory, magnetism.
d-block metals	12	Thu 17.2.	*d*-block metal oxides and other compounds.
Examination week for study period III (no lectures).			
Week 7	13	**Tue** 1.3.	At **12.30-14.00**. Defects, non-stoichiometric compounds.
Defects and doping	14	Wed 2.3.	Semiconductors, doping, electrical properties.
Final Wiki project deadline after mid-March.			

Literature for the course

- *Solid State Chemistry and its Applications* (2nd ed.), Anthony R. West, **2013**, Wiley.
- *Inorganic Structural Chemistry* (2nd ed.), Ulrich Müller, **2006**, Wiley.
- [Aalto Solid State Chemistry Wiki]