Solid State Chemistry
CHEM-E4155 (5 cr)

Spring 2023

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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?

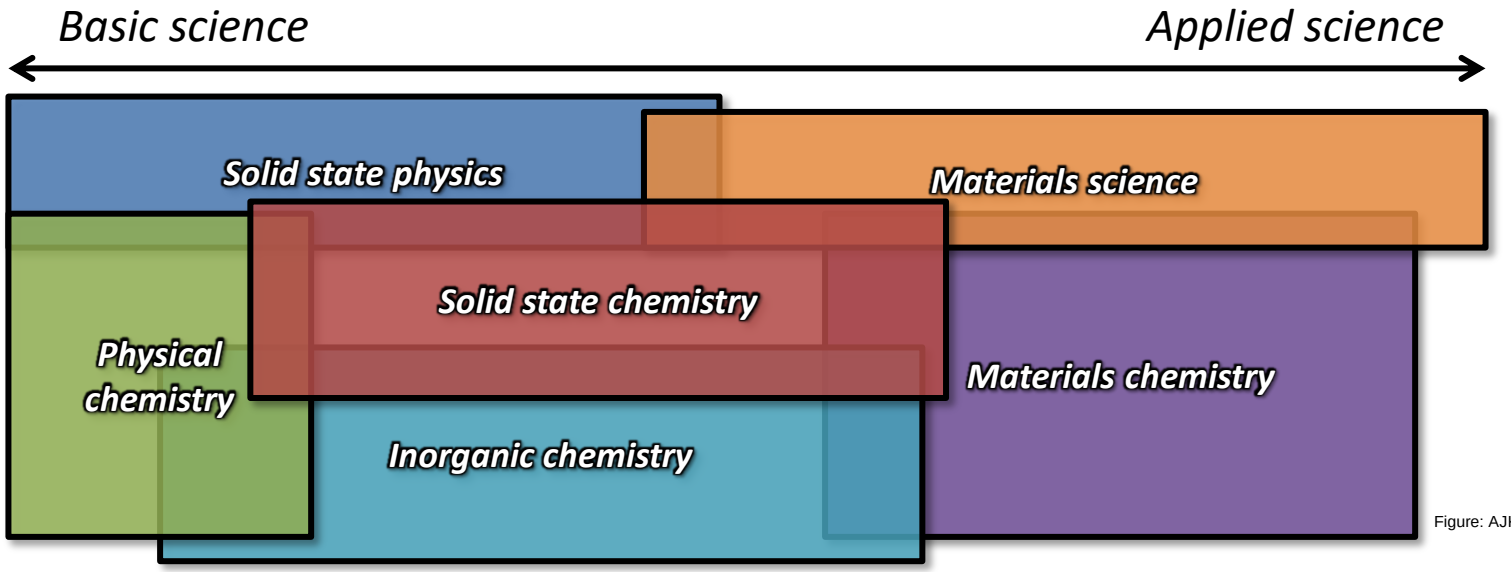

Figure: AJK

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.
  - Additionally: Zulip workspace for discussions and questions about exercises.
- **Wiki Project**
  - We create content in the Aalto Solid State Chemistry Wiki
  - Includes both independent and collaborative work (peer review)
- **Grading**
  - Exercises 50%, Wiki Project 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 lecture hall Ke2 (A304, Kemistintie 1)
Mon: 15:15-17.00
Tue: 10.15-12.00

Week	Lect.	Date	Topic
Week 1	1	Mon 9.1.	Structure of crystalline materials. Symmetry.
Structure	2	Tue 10.1.	Structural databases, visualization of crystal structures.
Week 2	3	Mon 16.1.	Bonding in solids. Description of crystal structures.
Bonding	4	Tue 17.1.	Band theory. Band structures.
Week 3	5	Mon 23.1.	Phase diagrams, crystal growth.
Synthesis	6	Tue 24.1.	Solid state synthesis.
Week 4	7	Mon 30.1.	XRD, Miller indices. Powder XRD databases. Microscopies.
Characterization	8	Tue 31.1.	Spectroscopies and thermal analysis.
Week 5	9	Mon 6.2.	Abundance of elements, geochemistry, minerals.
Main groups	10	Tue 7.2.	Main group compounds, allotropes, Zintl phases.
Week 6	11	Mon 13.2.	*d*-block metals, ligand field theory, magnetism.
d-block metals	12	Tue 14.2.	*d*-block metal oxides and other compounds.
Examination week for study period III (no lectures).			
Week 7	13	Mon 27.2.	**12.15-14.00, C100**. Defects, non-stoichiometric compounds.
Defects and doping	14	**Fri** 3.3.	**10.15-12.00, C100**. Semiconductors, doping.
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]