General Course Information

CHEM-E5120 Interfaces and Nanomaterials

2017

Aalto University

After this course you can

1. Combine **physical and chemical principles** that lead to the **characteristics of nanoscale materials**

2. Understands the origin of **self-assembly**

3. Determine the suitable **characterization methods** at nanoscale

4. **Analyse** measurement data at basic level

Before this course you should know

CHEM-A2120 Termodynamiikka (=”thermodynamics” or similar)

- Basic of thermodynamics: Gibb’s energy, enthalpy, entropy (1st and 2nd law of thermodynamics)

PHYS- A2140 Aineen rakenne (=“structure of matter” or similar course)

- Basics of Modern Physics: Schrödinger’s equation, particle-in-a-box problem, quantum numbers and electron configurations

CHEM- C2410 Materiaalit rakenteesta ominaisuuksiin(=“from stuctures to properties” or similar)

- Basics of material science: crystal structures, basics of electric, optic, magnetic, thermal and mechanical properties

Before this course it benefits if you know

CHEM- C2230 Pintakemia (= “surface science” or similar course)

- Basics of surface science: Van der Waal forces, electrostatic forces, DLVO theory, colloids & stability, contact angle & surface energy, adsorption isotherms

Lecture Schedule

THEME	LECTURE 1	LECTURE 2	EXERCISE SESSION
Introduction & Nanochemistry	**11.9.** Introduction to Nanoscale Science	**13.9.** Stability of Nanomaterials	**14.9.** Exercises
Self-assembly & Nanocarbons	**18.9.** Adsorption and self-assembly	**20.9.** Nanocarbons	**21.9.** Exercises
Properties at Nanoscale	**25.9.** Properties at Nanoscale I: Thermal, optical and mechanical	**27.9.** Properties at Nanoscale II: Electrical and magnetic	**28.9.** Exercises + **Abstract submission**
Characterization	**2.10.** Characterisation	**4.10**. Atomic level characterization *Visiting Lecturer: Prof. Peter Liljeroth*	**5.10.** Exercises
Nanotoxicity	**9.10.** Nanotoxicity and nanosafety	**11.10.** Pitching **Compulsory attendance**	**12.10.** Exercises
OUTCOME OF THE GROUP WORK	**16.10.** Course Review	**18.10.** (12-16) COSIO: Poster session **Compulsory attendance**	**N/A**

Course Material

The lecture slides are NOT enough as a reading material for the exam

- **Read the course books (available as e-books via library, links in MyCourses):**
  1. M.F. Ashby, P.J. Ferreira, D.L. Schodek*: Nanomaterials, Nanotechnologies and Design*
  2. G. Cao, Y. Wang: *Nanostructures and Nanomaterials - Synthesis, Properties, and Applications*
  3. *A.Y. Grosberg, A. R. Khokhlov, Giant Molecules – Here, There and Everywhere*

Course assessment: Max. Points from Different Tasks

Exercises	Abstract	Elevator pitch	Poster presentation	Exam	Total
15	**5**	**-**	**10**	**20**	**50**
	Compulsory	***Compulsory***	***Compulsory***	***Min. 7***	***Pass 50 % of total***

Lectures

- A/B/C voting via smart phones etc. ≈ **most important concepts**

Tight timetable: the home-exercises are discussed only in the exercise sessions

Lectures are NOT compulsory but recommended

Exercises

All exercises are available now in MyCourses

- **PART I questions: return latest on the 1st October**
  - **Total: 9 points (3 weeks)**
- **PART II questions: return latest on the 15th October**
  - **Total: 6 points (2 weeks)**

Exercises and Exercise Sessions are NOT compulsory

Exercises

1. **Calculate in your own time**
2. **Exercise sessions**

A place where you can ask help & get hints

Each week we'll concentrate on the exercises related to that week's topics

3. **Only the questions marked with asterisk (*) give points**

The other questions are for you own practice:

similar questions to non-graded questions might come to the exam, though

The correct answers of ALL PART I/PART II questions will be available in MyCourses after submission dates

Exercises

Submission of answers*

1. Take a photo from each, **hand-written** answer
2. Combine to ***a pdf file***
   - *One pdf file of Part I answers*
   - *Another pdf file of Part II answers*
3. Submit to MyCourses
   - Submission boxes: PART I and PART II *(exception: WEEK 5: Nanotoxicicty Quiz in MyCourses)*

**** The answers must be clearly visible (easy to read) in the pdf files***

Written Exam

You are allowed to bring with you

- Pens / pencils, eraser, ruler etc.
- Calculator
- **One A4, hand-written of your own notes**
  - All constants *(F*, *R*, k_B, etc.) and necessary equations are provided in the exam paper though
  - Equations or used symbols are **NOT** named or explained, you need to recognise the important equations from the long list of equations

Exam has 4 questions (á 5 points) → 20 points

Questions can be:

- Calculations
- Essays
- Explanations from schematics, concepts
- Combination of all the above

Remember these in written exam!

Course registration automatically includes registration for the course examination.

For other examinations, including make-up examinations or examinations for self-study courses, students must register no later than 7 days beforehand.

Only examination registrants may enter the examination hall.

Once 30 minutes have elapsed since the official commencement of the examination, no students will be let in the hall.

At the end of the examination, turn in all answer sheets, including empty ones, and question sheets.

Pair Work = Poster Project

More instructions for abstracts, posters and pitching on MyCourses

PAIR WORK: Poster

- ❑ Choose the theme, **read literature. Write** on the theme: *mind map, bullet points etc. (no submission, just for you)*
- ❑ Choose **a specific topic** within the theme (1-2 papers, from 2016-2017)
- ❑ **Write the abstract, max 1 A4 (DL: 28th September)**
- ❑ **Keep the elevator pitch (individual task)** on the topic (**11th October**)
  - 30 s talk
  - *best pitch gets awarded!*
- ❑ **Design** and make the poster
  - ❑ Make it in PowerPoint, submit as **pdf, DL: 15th October**
- ❑ **Present** the poster in the COSIO event (**18th October**)
  - Each group member presents separately

Themes

- **Super-repellent coatings**
- **Clean energy conversion and storage**
- **Nanosensors**
- **Nanotechnology for analytics**
- **Thin films: nanocarbons or ALD**

Read about the theme in general.
Choose **one specific topic** related to the theme.
Find **1-2** interesting scientific publications from years **2016-2017**.
Make your poster about them.

Poster Content

Choose **one specific topic** (related to one of the offered themes).

Find **1-2 interesting scientific publications from years 2016-2017**.

Each poster must contain also measurement data (not just schematics).

More figures, less text → better poster!

Poster Content

In order to be able to really explain your poster in a poster session:

- You need to study much more than those 1-2 papers
  - We may ask also general, theoretical questions related to your poster's theme.

PAIR WORK: Deadlines and Assessment

TASK	Deadline	Other Info	Assessment
Abstract Submission	**28th September**	*One A4*	Max. 6 p
Elevator Pitch	**11th October**	*30 s, **everyone** keeps*	N/A
Poster Submission	**15th October**	*One A0, submission as pdf*	Visuality: max. 5 p
Poster session	**18th October**	*COSIO Event (companies present)*	Presentation: max. 5p

More detailed instructions for abstracts, posters and pitching on MyCourses

Conference Abstract

- Different from the abstract of a scientific paper
- One A4 (no more!)
- Usually contain image(s)
- Proper references

Short background, main findings, possibilities/future prospects

A lure for your poster!

6th Baltic Electrochemistry Conference, Helsinki, 15th – 17th June, 2016

Photogeneration of Hydrogen at Liquid-Liquid Interface

Justyna Jedraszko[1], Wojciech Adamiak[1]*, Wojciech Nogala[1], Hubert H. Girault[2], and Marcin Opallo[1]

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ABSTRACT

Electron transfer reactions at liquid-liquid interfaces have been extensively studied for their promising use in the fuel production processes. Recently, Girault and co-workers [1] reported hydrogen photogeneration at polarized 1,2-dichloroethane(DCE)-water interface with decamethylruthenocene (DMRc) as the organic electron donor capable of reducing protons to hydrogen.

To further improve this process, we made an attempt to regenerate DMRc after hydrogen formation, by re-reduction of $DMRc^+$ in the organic phase. In our experiments, we used two Pt microelectrodes, one above each other, (Fig.1, left) and applied negative potential to the bottom one to re-reduce $DMRc^+$. At the same time, we did amperommetric scan with the upper electrode polarized to potential sufficiently positive to oxidize DMRc. We observed an increase of the anodic current on the upper electrode (Fig. 1, right), indicating that regeneration of DMRc is indeed possible. To detect photogenerated hydrogen, we used scanning electrochemical microscope tip to measure the open circuit potential in the vicinity of the DCE-water interface [2].

Fig. 1. Left: Scheme of a system for DMRc regeneration. Right: Anodic current recorded on the upper electrode during the amperommetric SECM scan above the bottom electrode.

We believe that light-induced processes, like hydrogen photogeneration at liquid-liquid interface, can be used in the future for energy storage systems which produce fuel during the day, whereas at night, they use surplus energy for electrochemical self-regeneration.

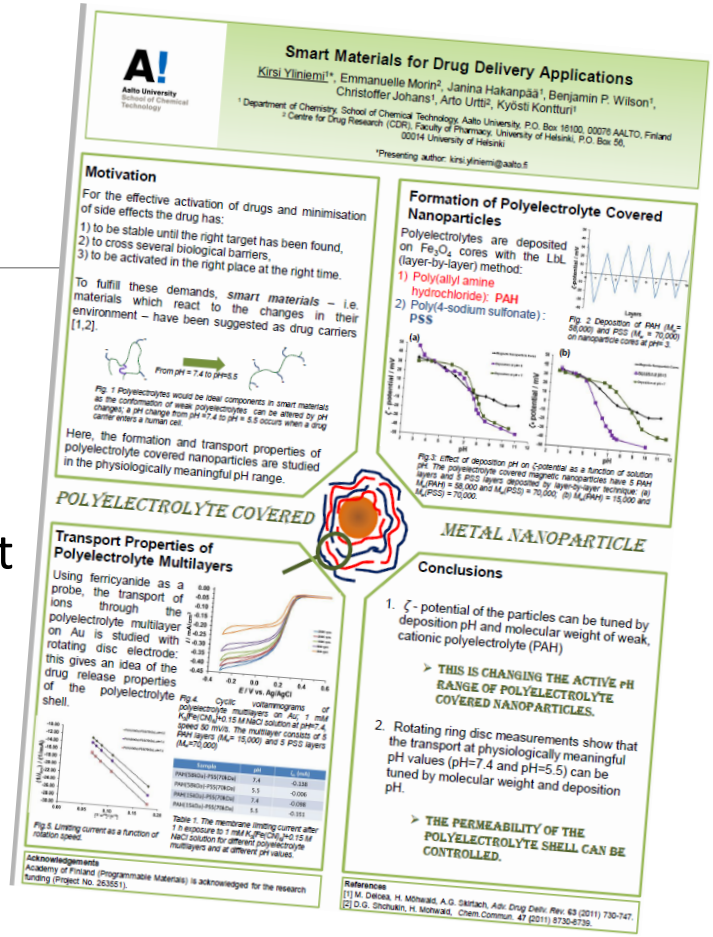
REFERENCES

[1] L. Rivier et al. *Decamethylruthenocene Hydride and Hydrogen Formation at Liquid|Liquid Interfaces* J. Phys. Chem. C, 119 (2015) 25761–25769.
[2] J. Jedraszko et al. *Scanning Electrochemical Microscopy Determination of Hydrogen Flux at Liquid|Liquid Interface with Potentiometric Probe*, Electrochem. Commun. 43 (2014) 22-24.

Conference Poster

A0, portrait (≈84 cm x 118 cm):
Make in PowerPoint, submit as pdf

- **Use large fonts**
  - main title>60 pt; sub-titles>55 pt; body text>40 pt
- **Hardly no text, more images (and data)**
  - You will explain your poster
  - Still, must have real content in writing too
  - Choose results **from 1-2 publication**



➢ **Difficult balance**

VISUALITY: colours, images AND

SCIENCE: content, references, story

COSIO

MEET THE STUDENTS OF AALTO FUNCTIONAL MATERIALS MASTER PROGRAMME

WHEN

Oct 18TH. 2017

12-16 pm

WHERE

Aalto University,
School of Chemical Engineering,
Kemistintie 1

Main lobby / Lecture hall Ke2

Poster presentations 18th October

12-14 Grading by teachers

- 1h / presenter
- When you are not presenting, circulate and ask questions from the other students
- Compulsory attendance

15-16 Companies present

- **Visit company stands**
- **Present your poster for company people**
- **free "mingling" but hopefully at least one of you by the poster most of the time**

Presenting a Poster

POSTER SESSION = DISCUSSION about science presented in the posters

➢ **One of you stands by the poster = presenter, others go from poster to poster to see and discuss about them**

❑ **Plan short "walk through talk" of your poster**

- 90 seconds or so
- What is the point of the poster: main results and conclusions

→ DISCUSSION

❑ **Be ready to answer to questions and discuss**

Questions may come already through your "walk through talk"

→ DISCUSSION

If no questions, be prepared to explain then some interesting part of the poster deeper

→DISCUSSION

DO NOT READ YOUR POSTER TO AUDIENCE/VISITORS (explain it)

YOU MAY HAVE NOTES WITH YOU BUT DO NOT READ THROUGH THEM EITHER

(notes should be just something you check if you have forgotten some small detail)