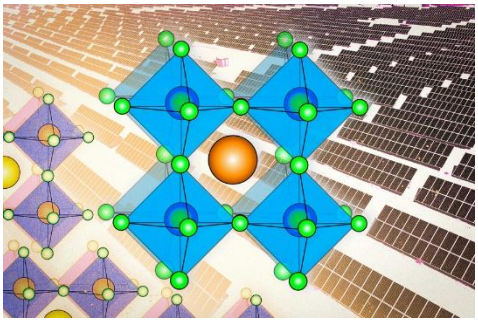
ENEG4130 Photovoltaic Materials and Devices (PVMD)

Instructor:
Prof. Yuanyuan (Alvin) Zhou, CBE,
Office: AB 4556
Email: yyzhou@ust.hk



Lecture times:
Tuesday 12:00 – 13:20 Venue: 4579
Thursday 12:00 – 13:20 Venue: 4579

Course Introduction:
This course elaborates on the fundamental basics, manufacturing, and process/device engineering of commercial and near-commercial photovoltaic technologies from the perspectives of materials science and chemical engineering. The knowledge imparted from this course will be key to the future of chemical/materials engineers in the solar energy industry.

Background (technology impact and career opportunities):
Photovoltaic (PV) is the most promising zero-carbon technology for electricity generation. Driven by the strong need to reduce the carbon footprint in Hong Kong and the world, the deployment of PVs on a large scale has become the trend in transforming our current energy landscape. Especially, the industry of PVs is growing in an unprecedentedly rapid manner, which creates a substantial number of job opportunities. To be ready for these unprecedented opportunities, the students are expected to not only learn the basics of PV principles, but to master the essential materials and chemical-engineering sciences in PVs. In particular, the field of PVs has experienced decades of developments, which have led to several promising technologies, respectively, named after the core materials used (Si, GaAs, CIGS, CdTe, perovskite, etc). As a future photovoltaic engineer, it becomes a mandate to master a systematic set of knowledge on these essential materials. Through this course, we expect to contribute to cultivating future chemical/materials engineers for the PV industry and widening the career path of our SUSEE and CBE students.

Course Intended Learning Outcomes (CILOs):

No.	Upon successful completion of this course, students should be able to:
1	Explain the properties of sunlight and its spectrum
2	Explain the basic principles of photovoltaics
3	Explain the structural basics and PV-related properties of (near-)commercial photovoltaic materials (Si, GaAs, CdTd, CIGS, and perovskite)
4	Explain the methodologies used to process and tailor each PV material
5	Explain the design principle and engineering methods of PV devices using each material
6	Summarize the updated PV industry
7	Produce a report and presentation on the cutting-edge developments of the PV industry

Assessment Methods:
Written assignments 30%: (2 homework assignments and 1 in-class quiz*)
Project: 30% (report 15% + presentation* 15%)
Final Examination: 40%

* The times for homework and quiz will be announced during the course progress.
* Presentation will be on 6 & 8 May, 2025. The project details are attached to this syllabus.

Course Materials:
PPT materials will be uploaded before the lectures.

Tentative Lecture Plan:

Week	**Topic**
04/02 (Tue)	Introduction to the course
06/02 11/02 (Tue)	Basics of the Sun and Sunlight
13/02	Materials fundamentals of semiconductors
18/02 (Tue)	Materials fundamentals of semiconductors
20/02	General principles of photovoltaics
25/02 (Tue)	General principles of photovoltaics
27/02 04/03 (Tue) 06/03	Si materials and solar cells
11/03 (Tue) 13/03	GaAs materials and solar cells
18/03 (Tue) 20/03	CdTe materials and solar cells
25/03 (Tue) 27/03	CIGS materials and solar cells
01/04 (Tue) (Mid-term break)	No class
03/04 (Mid-term break)	No class
08/04 (Tue) 10/04	Perovskite materials and solar cells (Guest Lectures by Dr. Tianwei Duan)
15/04 (Tue)	Solar cell fabrication and tests (lab observation)
17/04 22/04 (Tue)	Emerging PV materials and devices
24/04 29/04 (Tue)	Light management and system integration of photovoltaics
01/05	No class
06/05 (Tue) 08/05	Project presentation

ENEG4130 Project Task:

The students must choose one of the following areas and 'synthesize' knowledge from various resources.

- Science problems on the PV materials structure, synthesis, and processing
- Engineering problems on a specific type of PV device development
- Issues in the technology deployment and the mitigation pathways

The project deliverables for each student include an oral presentation and a report of ~1000 words (accurately and comprehensively explaining each slide).