National Cheng Kung University
Modular Course 2020 Summer Program

二維材料元件光學特性-基礎分析與實驗
O Optical characterization of 2D materials and devices – basics and experiment

Instructor	Affiliation	Graduation(Ph.d.)
周昱薰	**NCKU Department of Photonics**	**National Chiao Tung University**

Course Type	Course Credit	Student Size (Maximum)
Lab	**1.5**	**15**

Student Background

College of Science、Engineering College、College of Electrical Engineering and Computer Science

Format of The Course

Lecture30 %、Workshop60 %、Discussion 10 %

Grading Policy

Exam 30 %、Experimental operation 50 %、Participation 20 %

Note：

(I) The exam will be conducted at the beginning of the third class (1 hour) to ensure the students understand the lecture notes in the past two days.

(II) Operation grading criteria: 1. Did students follow the standard procedures or not? (30%) 2. whether the experimental results are consistent with the lecture content (15%) 3. complete the experiment within the class period. (5%))

Code of Conduct for The Course

No eating in class

Course Description

To break the limitation of Moore's law, people have begun to consider using thinner and better materials to replace the components in semiconductor devices. Two-dimensional materials with only single molecule thicknesses are one of them. From graphene to transition metal dichalcogenide, researchers are fascinated by their beautiful properties. This course will lead students to learn the background knowledge of two-dimensional materials (lecture notes), lead everyone to make two-dimensional materials by mechanical exfoliation (fabrication experiment), how to make simple two-dimensional devices by layered stacking method (manufacture experiment), and excite the samples with light to measure the energy gap under different bias (measurement experiment)

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Timetable and Syllabus

Period	Timetable	Syllabus
8/17(MON)	**9:00-17:30**	**9:00-10:00 Course Introduction** **10:00-12:00 Basic quantum physics** **12:00-13:00 Lunch break** **13:00-14:00 Band theory** **14:00-15:30 Light-matter interaction** **15:30-17:30 Fundamentals of Semiconductor Optics**
8/18(TUE)	**9:00-17:30**	**9:00-10:00 Steps for scientific literature review,** **10:00-12:00 2D material literature review** **12:00-13:00 Lunch break** **13:00-14:00 Sample fabrication-mechanical exfoliation (lecture)** **14:00-15:30 Sample fabrication-layer stacking (lecture)** **15:30-16:30 Fundamentals of lasers** **16:30-17:30 Photoluminescence techniques and application (lecture)**
8/19(WED)	**9:00-17:30**	**9:00-10:00 Exam** **10:00-17:30 Mechanical exfoliation method (experiment)** **Including lunch break for 1 hour, the actual time depends on the progress of the experiment.**
8/20(THU)	**9:00-17:30**	**9:00-17:30 How to make a simple 2D material light-emitting device (experiment)** **Including lunch break for 1 hour, the actual time depends on the progress of the experiment.**
8/21(FRI)	**9:00-17:30**	**9:00-17:30 Investigating the fabricated device by photoluminescence (experiment)** **Including lunch break for 1 hour, the actual time depends on the progress of the experiment.**

Goal of The Course

1.Learning the background of semiconductor optics

2.Learning the knowledge of 2D materials

3.Learn to make simple 2D material elements

4. Teamwork organizing

5. Explore cutting-edge knowledge

6. Laser measurement

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The Importance, Cross-Over Disciplinary and Contemporary of The Curriculum

Importance: Two-dimensional materials are currently the most competitive research topic. Researchers from industry and academics are actively developing the applications of 2D materials. Through this course, students can quickly connect to the most critical research topics currently.
Timeliness: Silicon-based semiconductor devices will reach the limits of Moore's Law in the next ten years. Taking this course will keep students informed of the latest research advances.
Interdisciplinarity: Through teamwork, students will learn interdisciplinary knowledge, such as basic optics, basic chemistry, semiconductor physics, and 2D material fabrication techniques.

Remarks

References：

There are currently no suitable books, so that I will refer to a large number of research papers.