课程编号：99911218

课程名称：下一代半导体：有机光电技术与大科学装置

(Next-Generation Semiconductors: Organic Optoelectronic and Large Scale Scientific Facility)

1. 课堂讲授学时 **Lecture Hours：32**
2. 课堂实验学时 **Laboratory Hours：0**
3. 课下研讨学时 **Colloquia Hours：8**
4. 学生课下投入学时 **Individual Study Hours：8**
5. 学分 **Credits：2**
6. 开课学年学期（如果有强制性的要求则必须填，否则可以不填）**Occurrence**：
7. 先修课程 **Prerequisite(s):** 必须先修的课程直接写课程编号和课程名称，建议先修的课程在课程名称后用*号标注，并在下一行注明：***Recommended, not required as prerequisite：Physics (物理学)**
8. 课程概要 **Course Description:** 100 字以内，学习内容以学术关键词出现。

   This course focuses on novel organic semiconductor materials based on π-conjugated carbon compounds. Key topics include electronic structures, charge transport mechanisms, and applications in LEDs, transistors, and photovoltaics. A core feature of the course is the integration of large-scale scientific facilities (e.g., HEPS, Elettra). It systematically introduces state-of-the-art operando spectroscopy, time-resolved spectroscopy, and nanophotonics in the context of characterizing frontier materials.

   本课程聚焦基于 π 共轭碳化合物的新型有机半导体材料 。重点探讨材料的电子结构、电荷传输机制及其在 **LED**、晶体管及光伏电池中的应用 。课程核心在于结合同步辐射大科学装置（如 **HEPS** 等），系统介绍原位能谱技术、时间分辨光谱及纳米光子学在前沿材料表征中的典型应用。
9. 课程预期学习成果 **Course Outcomes:** 用数字 1 到 9 列出每一项主要学习成果

   (1) Understand the logical connection between molecular architecture and macroscopic device response.

   (2) Master the fundamental theories of electronic band structure and the photoelectric effect.

   (3) Gain familiarity with the operational principles and scientific value of synchrotrons

and large-scale facilities.

(4) Develop the ability to analyze surfaces and interfaces of 2D materials using advanced techniques like Core-level Photoelectron Spectroscopy (PES).

(5) Demonstrate the capacity to observe real-time physical processes using time-resolved spectroscopy.

(6) Enhance professional presentation and discussion skills within international academic environments.

(1) 理解有机半导体的分子架构与宏观器件响应之间的逻辑联系 。

(2) 掌握半导体电子能带结构及光电效应的基本理论。

(3) 熟悉同步辐射及大型科研基础设施（Large-scale facilities）的操作原理与科研价值。

(4) 具备利用最先进的能谱技术（如芯能级光电子能谱）分析二维材料表面与界面的能力。

(5) 能够运用时间分辨光谱观察材料中的实时物理过程。

(6) 提升在国际学术环境下进行专业汇报与前沿科学问题讨论的能力。

10. **教学内容与学时分配 Course Content, Laboratories and Laboratory Hours（有则填，没有则不填）, Colloquia Hours（有则填，没有则不填）：**各章节目录与学时，实验内容与学时，研讨内容与学时

(1) Fundamentals of Semiconductors (4h): Electronic band structures; Introduction to the photoelectric effect.半导体中的电子能带结构；光电效应导论。

(2) Chemistry of Organic Semiconductors (4h): Design and synthesis of organic semiconductors; Small molecules vs. polymeric structures.有机半导体设计与合成基础；小分子与聚合物结构。

(3) Advanced Spectroscopic Techniques (8h): Core-level PES; Time-resolved spectroscopies; Real-time observation of physical processes.芯能级光电子能谱；时间分辨光谱；实时物理过程观察。

(4) Surfaces, Interfaces, and 2D Materials (4h): Investigating surfaces and interfaces with photoelectron spectroscopy.利用光电子能谱研究二维材料表面与界面。

(5) Nanotechnology and Photonics (4h): Frontiers in nanotech and photonics; Applications of synchrotron radiation.纳米技术与光子学前沿；同步辐射技术应用。

(6) Synchrotrons and Large-scale Facilities (4h): Global overview of facilities; Computational methods (DFT, GW, etc.).全球同步辐射光源及大科学装置综述；计算电子结构方法（DFT, GW 等）。

(7) Colloquia and Group Work (8h): Student introductions, thematic presentations, and academic discussions.学生个人介绍、专题汇报与学术讨论。

(8) Exams and Closing (4h): Final examination and course conclusion.课程考试及结业

总结。

11. 考核与成绩评定 **Grading:**

Homework (课后作业**): 20%**

Group Presentation/Speech (小组汇报**/**学生发言**): 50%**

Final Exam (课程考试**): 30%**

12. **教材，参考书 Text & Reference Book:** 作者，书名，版本，年份，国际标准书号 ISBN

Selected reviews on Organic Electronics and Synchrotron Radiation techniques;

Lecture notes from Elettra and BIT.

13. 编写教师 **Course Lecturer：**

Cesare Grazioli, 张腾（Teng ZHANG）

编写教师 **Course Lecturer**（签字）：