

课程大纲 COURSE SYLLABUS

1.	课程代码/名称 Course Code/Title	PHY5013/先进电子显微学 Advanced Electron Microscopy
2.	课程性质 Compulsory/Elective	专业选修课 Elective Course
3.	课程学分/学时 Course Credit/Hours	3/64
4.	授课语言 Teaching Language	英文 English
5.	授课教师 Instructor(s)	林君浩 Junhao Lin
6.	是否面向本科生开放 Open to undergraduates or not	是 YES
7.	先修要求 Pre-requisites	(如面向本科生开放, 请注明区分内容。 If the course is open to undergraduates, please indicate the difference.) 固体物理 PHY321-15 Introduction to Solid State Physics
8.	教学目标 Course Objectives	(如面向本科生开放, 请注明区分内容。 If the course is open to undergraduates, please indicate the difference.) 这是一门 3 学分的课程, 目标是培养学生透射电子显微镜的实验技术, 和对透射电子显微技术原理的掌握。课程中的理论课会教授透射电子显微镜的工作原理, 同时注重实验实践, 让学生在实验中发掘需求, 以期为后续研究性学习打下坚实基础。 This is a 3-credit course offered for the students to become competent, research-level electron microscopists. They will understand the functions of TEM & SEM and how it works. They will be competent in basic operating techniques, and learn more advanced ones as needed.
9.	教学方法 Teaching Methods	(如面向本科生开放, 请注明区分内容。 If the course is open to undergraduates, please indicate the difference.) 理论课与实验课结合 Classes on both theory and experiments
10.	教学内容 Course Contents	(如面向本科生开放, 请注明区分内容。 If the course is open to undergraduates, please indicate the difference.)
	Section 1	电子显微学简介, 内容包括(但不限于): 电子显微学发展历史; 电子发射源; 电磁透镜, 光阑和分辨率的概念; 真空泵与样品杆; 辐照损伤; 电镜构成; 电镜制样 Introduction of Electron Microscopy History of Electron Microscopy; electron sources; lenses, apertures, and resolution; pump and holders; Beam damage; factory of instruments; specimens preparation

Section 2	<p>电子衍射原理 电子散射（弹性与非弹性散射）与电子衍射原理；倒空间；晶体结构；衍射束和布洛赫波；平行电子束与双束条件；汇聚光电子衍射花样</p> <p>Electron Diffraction Electron Scattering (elastic and inelastic) and electron diffraction; reciprocal space; crystal structures; diffracted beam and Bloch waves; parallel beam or two beam conditions; CBED</p>
Section 3	<p>成像 振幅衬度；相位衬度；材料缺陷；高分辨透射电子显微技术；背散射电子成像；电子全息；电子断层成像；磁成像；原位探测技术；扫描透射电子显微技术；冷冻电镜技术；图像模拟；扫描电镜</p> <p>Imaging Amplitude contrast; phase contrast; defects in materials; High resolution-TEM; backscattered electron imaging; electron tomography; electron holography; magnetic imaging; In situ-TEM; Scanning TEM; Cryo TEM; Image processing and simulation; SEM</p>
Section 4	<p>电子谱学 X 射线光谱仪与成像；定量 X 射线分析；电子损失能谱与能量过滤器；近边精细结构与超精细结构</p> <p>Spectrometry X-ray spectrometry and images; Quantitative X-ray analysis; electron energy loss spectrometers and filters; ELNES and EXELFS</p>
Section 5	<p>透射电子显微学在先进材料中的应用 在不同领域列举一些透射电子显微学发挥重要作用的例子</p> <p>Applications in advanced Materials Some important examples in varied research fields by electron microscopy</p>

11. 课程考核
Course Assessment

(① 考核形式 Form of examination; ②. 分数构成 grading policy; ③ 如面向本科生开放, 请注明区分内容。
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平时成绩 30%, 实验成绩 30%, 期末闭卷考试成绩 40%。
Homework 30%, experiments 30%, final exam 40%.

12. 教材及其它参考资料
Textbook and Supplementary Readings

教材 (textbook) :
David B. Williams and C. Barry Carter, Transmission Electron Microscopy: A Textbook for Materials Science, 2009.

参考资料 (reference) :
(1)John C. H. Spence, High Resolution Electron Microscopy, Third Ed. 2003.
(2)Earl J. Kirkland, Advanced Computing in Electron Microscopy, 2009.
(3)Joachim Frank, Electron Tomography, 2005.
(4)R. F. Egerton, Electron Energy Loss Spectroscopy, 1996.
(5)Edgar Volkl, Lawrence F. Allard, David C. Joy, Introduction to Electron Holography, 1999.
(6)J.C.H. Spence, and J. M. Zuo, Electron Microdiffraction, 1992.
(7)Robert J. Keyse et al, Introduction to Scanning Transmission Electron Microscopy, 1998.