

## 课程详述

### COURSE SPECIFICATION

以下课程信息可能根据实际授课需要或在课程检讨之后产生变动。如对课程有任何疑问，请联系授课教师。

The course information as follows may be subject to change, either during the session because of unforeseen circumstances, or following review of the course at the end of the session. Queries about the course should be directed to the course instructor.

1.	<b>课程名称 Course Title</b>	晶体化学 Crystal Chemistry
2.	<b>授课院系 Originating Department</b>	材料科学与工程系 Department of Materials Science and Engineering
3.	<b>课程编号 Course Code</b>	MSE342
4.	<b>课程学分 Credit Value</b>	3
5.	<b>课程类别 Course Type</b>	专业选修课 Major Elective Courses
6.	<b>授课学期 Semester</b>	春季 Spring
7.	<b>授课语言 Teaching Language</b>	中英双语 English & Chinese
8.	<b>授课教师、所属学系、联系方式 (如属团队授课, 请列明其他授课教师) Instructor(s), Affiliation &amp; Contact (For team teaching, please list all instructors)</b>	汪宏, 讲席教授 Hong Wang, PhD Chair Professor Department of Materials Science and Engineering wangh6@sustc.edu.cn
9.	<b>实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact</b>	待公布 To be announced
10.	<b>选课人数限额(可不填) Maximum Enrolment (Optional)</b>	

11. 授课方式 Delivery Method	讲授 Lectures	习题/辅导/讨论 Tutorials	实验/实习 Lab/Practical	其它(请具体注明) Other (Please specify)	总学时 Total
学时数 Credit Hours	48				48
12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	MSE001 材料科学与工程基础 Fundamentals of Materials Science and Engineering				
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite					
14. 其它要求修读本课程的学系 Cross-listing Dept.	物理系 PHY、化学系 CH				

### 教学大纲及教学日历 SYLLABUS

#### 15. 教学目标 Course Objectives

本课程主要讲述晶体、准晶体、非晶体的结构和对称性，以及金属、陶瓷、玻璃、聚合物等重要材料的晶体结构、原子模型和相关的晶体化学原理，使学生了解和掌握晶体物理和化学性质与晶体结构、微结构之间的联系，并理解有关原理和知识在材料设计制备和工程实践中的重要性。

##### COURSE OBJECTIVES:

- 1). To identify important raw materials and minerals as well as their names and chemical formulas.
- 2). To describe the crystal structure of important materials and be able to build their atomic models.
- 3). To learn the systematics of crystal and glass chemistry.
- 4). To understand how physical and chemical properties are related to crystal structure and microstructure.
- 5). To appreciate the engineering significance of these ideas and how they related to industrial products: past, present and future.

#### 16. 预达学习成果 Learning Outcomes

学生将掌握晶体化学的基本原理，尤其是典型的晶体结构及其结构性能关系，从而指导和应用于新材料设计和研发。

After learning, the students are expected to have the knowledge of the principles of crystal chemistry, especially to grasp the typical crystal structures and their structure-property relationship and therefore to benefit the conceptual use in materials design and development

#### 17. 课程内容及教学日历 (如授课语言以英文为主, 则课程内容介绍可以用英文; 如团队教学或模块教学, 教学日历须注明主讲人)

**Course Contents (in Parts/Chapters/Sections/Weeks. Please notify name of instructor for course section(s), if this is a team teaching or module course.)**

Section 1 Introduction (1 Credit Hour) 绪论

Introduce the course contents, objectives and the development of relative crystalline materials. 介绍本门课程的内容、目的和相关领域的发展趋势。

Section 2 Chemical elements, minerals and ceramic raw materials (2 Credit Hours) 化学元素、矿物和陶瓷原材料

Lecture on the abundance of elements, chemical elements and oxides, typical minerals and ceramic raw materials. 讲授元素丰度、元素及其氧化物、典型矿物和主要陶瓷原材料等。

Section 3 Chemical bonding and electronegativity (3 Credit Hours) 化学键和电负性

Lecture on the bond types, bond strength, bond length, bonds with mixed character and electronegativity. 讲授化学键的种类、键强、键长，混合键性，电负性的概念等。

Section 4 Crystal systems, atomic structure and closed packing (3 Credit Hours) 晶系和原子结构和密堆积

Lecture on the crystal systems, unit cells, density, ionic radii, atomic structure and closed packing. 讲授晶系、晶胞、密度、离子半径、密堆积和原子结构等。

Section 5 Geometric crystallography (6 Credit Hours) 几何结晶学

Lecture on the crystal symmetry, point groups, symmetry elements and applications. 讲授晶体对称性、点群、对称操作和应用等。

Section 6 X rays diffraction (3 Credit Hours) X 射线衍射

Lecture on the principles of X rays diffraction and the applications in crystal characterization. 讲授 X 射线衍射基本原理及其在晶体结构分析中的应用。

Section 7 Pauling rule (3 Credit Hours) 鲍林规则

Lecture on the Pauling rule and the application, polymorphs, solid solutions. 讲授鲍林规则五条规则及其结构分析应用，多形体、固溶体等概念。

Section 8 Typical crystal structures (6 Credit Hours) 典型晶体结构

Lecture on tetrahedron, octahedron crystal structure cells, typical crystal structures and their related properties and applications. 讲授四面体、八面体等晶体基本构成单元，典型的晶体结构及其性能和应用。

Section 9 Crystal field theory (3 Credit Hours) 晶体场理论

Lecture on crystal field theory, Jahn-Taylor effect and their applications. 讲授晶体场理论、姜-泰勒效应及其应用。

Section 10 Phase diagram and phase transformation (6 Credit Hours) 相图和相变

Lecture on phase diagram, phase transformation and the influence on the materials properties. 讲授相图种类、典型相变类型以及对相关性能的影响规律。

Section 11 Defects in crystals (3 Credit Hours) 晶体中的缺陷

Lecture on the defect types, formation, interact mechanism and the influence on the materials properties. 讲授缺陷类型、形成和作用机理、对性能的影响规律。

Section 12 Amorphous solid, liquid crystal and quasicrystal (3 Credit Hours) 非晶、液晶和准晶

Lecture on amorphous solid, liquid crystal, quasicrystal, and their structure-properties relationships. 讲授非晶、液晶和准晶概念，结构与性能关系。

Section 13 Structure-properties relationship and new material design (6 Credit Hours) 结构-性能关系与新材料设计

Lecture on the material design concept, and how to use the crystal chemistry to instruct the materials development. 讲授材料设计概念，如何将晶体化学与材料研发相结合。

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

1. S. Trolier-McKinstry, R. E. Newnham, Materials Engineering, Cambridge University Press, 2017, ISBN 978-1-107-10378-8
2. R. E. Newnham, Properties of Materials: Anisotropy, Symmetry, Structure. Oxford University Press, 2005, ISBN 0-19-852075-1
3. Edward R.T. Tiekink and Jagadese J. Vittal, Frontiers in Crystal Engineering. John Wiley & Sons, Ltd. 2006, ISBN: 0-470-02258-2
4. 钱逸泰, 结晶化学导论, 中国科学技术大学出版社, 2002, ISBN7-312-01088-1
5. R. C. Evans, An Introduction to Crystal Chemistry, Cambridge University Press, 1964

**课程评估 ASSESSMENT**

19. 评估形式 Type of Assessment	评估时间 Time	占考试总成绩百分比 % of final score	违纪处罚 Penalty	备注 Notes
出勤 Attendance		10		
课堂表现 Class Performance				
小测验 Quiz				
课程项目 Projects		25		
平时作业 Assignments		25		
期中考试 Mid-Term Test				
期末考试 Final Exam		40		
期末报告 Final Presentation				
其它(可根据需要 改写以上评估方 式) Others (The above may be modified as necessary)				

20. 记分方式 GRADING SYSTEM

- A. 十三级等级制 Letter Grading  
 B. 二级记分制 (通过/不通过) Pass/Fail Grading

**课程审批 REVIEW AND APPROVAL**

21. 本课程设置已经过以下责任人/委员会审议通过  
 This Course has been approved by the following person or committee of authority