

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.	课程名称 Course Title	金属材料 Physical Metallurgy				
2.	授课院系 Originating Department	材料科学与工程系 Department of Materials Science and Engineering				
3.	课程编号 Course Code	MSE329				
4.	课程学分 Credit Value	2				
5.	课程类别 Course Type	专业核心课 Major Core Courses				
6.	授课学期 Semester	Fall 秋季				
7.	授课语言 Teaching Language	英文 English				
8.	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 & Contact (For team teaching, please list all instructors)	余鹏 副教授 Dr. Peng Yu, Department of Materials Science and Engineering yup@sustc.edu.cn				
9.	实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact	待公布 To be announced				
10.	选课人数限额(可不填) Maximum Enrolment (Optional)					
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	32				32

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.	

教学大纲及教学日历 SYLLABUS

15. **教学目标 Course Objectives**

金属学是材料科学与工程系学生的一门选修课，其目的是使学生掌握金属材料的基础知识。了解金属及合金的成分、组织、结构与性能之间的相互关系及其变化规律。掌握常用材料的组织结构形成与变化规律，同成分、外界条件之间的关系，及其对材料性能的影响。了解常用金属材料的制造和热处理工艺，以及其在工业中的应用。并对金属材料的前沿研究有初步的认识。

Fundamental of Physical Metallurgy is an elective course for students in Department of Materials Science and Engineering, aiming to instruct the basic knowledge of metal materials to students. Understand the relationship and change rules among the composition, structure and properties of metals and alloys. Master the formation and change rules of the structure in conventional materials, the relationship among structure, composition and external conditions, and the effect on the properties of materials. Understand the manufacturing and heat treatment processes in conventional metal materials and their applications in industry. Have a preliminary understanding of the frontier research of metal materials.

16. **预达学习成果 Learning Outcomes**

通过本课程的学习，应使学生掌握金属及合金的成分、组织、结构与性能之间的相互关系及其变化规律；掌握和金属相关的热力学、扩散、界面、金属的凝固、扩散型相变以及非扩散型相变的知识。了解工业中常用的结构材料如钢、铝合金、铜合金、钛合金等的制造和热处理方法。同时了解金属领域出现的新材料如金属玻璃、形状记忆合金的研究状况。使学生初步学会使用金相显微镜对金属及合金的组织进行观察及相应的实验技能；能够运用所学的理论对一些典型的实际工程问题进行大致的分析。

Through the study of this course, students should master the relationship and change rules among the composition, structure and properties of metals and alloys. Master the knowledge of thermodynamics, diffusion, interface, metal solidification, diffusional transformation and diffusionless transformation in metal materials. Understand the manufacturing and heat treatment methods of common structural materials such as steel, aluminium alloys, copper alloys and titanium alloys. Meanwhile understand the research progress of some new metal materials such as metallic glass, shape memory alloys. Learn to use metallographic microscope to observe the microstructure in metals and alloys and master corresponding experimental skills. After finishing the course, students are expected to use the learned theories to briefly analyse some typical practical engineering problems.

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.)

1. 热力学及相图 (5 课时) Thermodynamics and Phase Diagrams (5 Credit hours)
 - 平衡 Equilibrium
 - 单组元系统 Single Component Systems
 - 二元溶液 Binary Solutions
 - 非均匀系统中的平衡 Equilibrium in Heterogeneous Systems
 - 二元相图 Binary Phase Diagrams
 - 界面对平衡的影响 The Influence of Interfaces on Equilibrium
 - 三元平衡 Ternary Equilibrium
 - 二元溶液的其他热力学关系 Additional Thermodynamic Relationship for Binary Solutions
 - 相变动力学 The Kinetics of Phase Transformations
2. 扩散 (5 课时) Diffusion (5 Credit hours)
 - 扩散的原子机制 Atomic Mechanisms of Diffusion
 - 间隙扩散 Interstitial Diffusion
 - 置换扩散 Substitutional Diffusion
 - 原子迁移率 Atomic Mobility
 - 二元合金中的示踪原子扩散 Tracer Diffusion in Binary Alloys
 - 高扩散率通道 High Diffusivity Paths
 - 多相二元系中的扩散 Diffusion in Multiphase Binary Systems
3. 晶体的界面和显微组织 (6 课时) Crystal Interfaces and Microstructure (6 Credit hours)
 - 界面自由能 Interfacial Free Energy
 - 固/气界面 Solid/Vapour Interfaces
 - 单相固体中的晶界 Boundaries in Single-Phase Solids
 - 固体中的相界面 Interphase Interfaces in Solids
 - 界面迁移 Interface Migration
4. 凝固 (5 课时) Solidification (5 Credit hours)

- 纯金属中的形核 Nucleation in Pure Metals
 - 纯固相的长大 Growth of a Pure Solid
 - 合金凝固 Alloy Solidification
 - 铸锭和铸件的凝固 Solidification of Ingots and Castings
 - 熔焊的凝固 Solidification of Fusion Welds
 - 从溶体淬火的凝固 Solidification during Quenching from the Melt
 - 一些铸件和焊件的研究实例 Case Studies of some Practical Castings and Welds
5. 固态中的扩散型相变 (6 课时) Diffusional Transformations in Solids (6 Credit hours)
- 固相中的均匀形核 Homogeneous Nucleation in Solids
 - 非均匀形核 Heterogeneous Nucleation
 - 脱溶物长大 Precipitate Growth
 - 综合转变动力学: TTT 图 Overall Transformation Kinetics-TTT Diagrams
 - 时效强化合金中的脱溶 Precipitation in Age-Hardening Alloys
 - 铁素体在奥氏体中的脱溶 The Precipitation of Ferrites from Austenite
 - 胞状脱溶 Cellular Precipitation
 - 共析转变 Eutectoid Transformations
 - 块型转变 Massive Transformations
 - 有序化转变 Ordering Transformations
 - 研究实例 Case Studies
6. 无扩散型转变 (5 课时) Diffusionless Transformations (5 Credit hours)
- 无扩散型转变的特点 Characteristics of Diffusionless Transformations
 - 马氏体晶体学 Martensite Crystallography
 - 马氏体形核理论 Theories of Martensite Nucleation
 - 马氏体长大 Martensite Growth
 - 预马氏体现象 Pre-martensite Phenomena

- 铁基马氏体的回火 Tempering of Ferrous Martensites
- 研究实例 Case Studies

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

1. Phase Transformations in Metals and Alloys, 2nd Ed., D.A. Porter and K.E. Easterling, Taylor & Francis, 2004, New York
2. 金属学原理, 余永宁, 冶金工业出版社, 2000, 北京

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				
平时作业 Assignments		40		
期中考试 Mid-Term Test				
期末考试 Final Exam		50		
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



南方科技大学
SOUTHERN UNIVERSITY OF SCIENCE AND TECHNOLOGY

