

# 上海交通大学研究生专业课程信息收集表

## Information Form for SJTU Graduate Profession Courses

课程基本信息 Basic Information				
<b>*课程名称</b> Course Name	(中文 Chinese) 复合材料制备科学			
	(英文 English) Preparation Science of Composite Materials			
<b>*学分</b> Credits	2	<b>*学时</b> Teaching Hours	32 (1 学分=16 课时)	
<b>*开课学期</b> Semester	秋季学期 Fall	<b>*是否跨学期</b> Cross-semester?	否 No	跨 Spanning over 个学期 Semesters (含夏季学期)。
<b>*课程类型</b> Course Type	专业选修课 Program Elective Course	<b>*课程分类</b> Course Type	全日制课程 For full-time students	
<b>*课程性质</b> Course Category	专业课 Specialized Course	课程层次 Targeting Students	博士课程 Doctoral Level	
<b>*授课语言</b> Instruction Language	中文 Chinese	主要授课方式 Teaching Method	课堂教学 In class teaching	
<b>*成绩类型</b> Grade	等第制 Letter grading	主要考核方式 Exam Method	论文 Essay	
<b>*开课院系</b> School	材料科学与工程学院			
所属学科 Subject	材料科学			
<b>负责教师</b> Person in charge	姓名 Name	工号 ID	单位 School	联系方式 E-mail
	张荻		材料学院	zhangdi@sjtu.edu.cn
课程扩展信息 Extended Information				
<b>*课程简介</b> (中文) Course Description	<p>(分段概述课程定位、教学目标、主要教学内容、先修课程等；不少于 200 字。)</p> <p>本课程在本科复合材料相关课程的教学基础上，进一步为材料科学与工程等相关专业研究生提供更为前沿全面的专业教育。该课程的学习重点是使学生能够较全面和系统地理解复合材料制备科学的重要基本概念和理论，复合材料制备研究中的制备工艺、界面特征和结构设计以及复合材料，特别是先进复合材料的发展趋势，同时具有初步的复合材料制备研究和设计能力。为学生今后在复合材料领域的深造和专门研究奠定较坚实的基础。</p> <p>通过学习，学生将具备以下几方面的能力：</p> <ol style="list-style-type: none"> <li>1. 掌握复合材料结构、组成、工艺过程及设备、性能与应用之间关系的基本规律；</li> <li>2. 掌握复合材料制备与工程研究、开发设计与应用的理论基础和实验技能，具有对复合材料进行材料设计、结构设计、工艺设计、开发先进复合材料及制品的能力；</li> <li>3. 掌握材料微观结构、性能的现代测试方法和宏观生产过程的工程测试技术；</li> <li>4. 掌握复合材料的成型加工技术和设备原理；</li> <li>5. 了解复合材料学科前沿发展信息；</li> <li>6. 具有较强的自学能力、工程实践能力和一定的创新能力。</li> </ol>			

<p>*课程简介 (English) Course Description</p>	<p>(须与中文一致, 翻译请力求信达雅。)</p> <p>Based on the teaching of composite materials related courses, this course further provides more cutting-edge and comprehensive professional education for graduate students in materials science and engineering. The focus of this course is to enable students to comprehensively and systematically understand the important basic concepts and theories of composite material preparation science, the preparation process, interface characteristics and structural design in composite material preparation research, as well as the development trend of composite materials, especially advanced composite materials. At the same time, students have the preliminary ability of composite material preparation research and design. It will lay a solid foundation for students to further study and specialized research in the field of composite materials in the future.</p> <p>Through learning, students will have the following abilities:</p> <ol style="list-style-type: none"> <li>1. Master the basic laws of the relationship between the structure, composition, process, equipment, performance and application of composite materials;</li> <li>2. Master the theoretical basis and experimental skills of composite material preparation and engineering research, development design and application, and have the ability of material design, structural design, process design and development of advanced composite materials and products;</li> <li>3. Master the modern testing method of material microstructure and performance and the engineering testing technology of macro production process;</li> <li>4. Master the forming and processing technology and equipment principle of composite materials;</li> <li>5. Understand the frontier development information of composite materials;</li> <li>6. Have strong self-study ability, engineering practice ability and certain innovation ability.</li> </ol>
<p>*教学大纲 (中文) Syllabus</p>	<p>(建议列表形式, 各列内容: 章节、主要内容、课时数、教学方式等)</p> <p><b>第一章 绪论</b></p> <ol style="list-style-type: none"> <li>一、 复合材料的研究意义</li> <li>二、 复合材料的发展历史</li> <li>三、 复合材料概述       <ol style="list-style-type: none"> <li>1、 复合材料的定义</li> <li>2、 复合材料的特点</li> <li>3、 复合材料的基本结构模式</li> </ol> </li> <li>四、 课程的重点和要求</li> </ol> <p><b>第二章 复合材料界面</b></p> <ol style="list-style-type: none"> <li>一、 复合材料的界面</li> <li>二、 复合材料的相容性</li> <li>三、 复合材料的界面理论</li> <li>四、 界面结合强度</li> <li>五、 界面残余应力</li> </ol> <p><b>第三章 复合材料基体</b></p> <ol style="list-style-type: none"> <li>一、 金属       <ol style="list-style-type: none"> <li>1、 铝、镁及其合金</li> <li>2、 钛及其合金</li> <li>3、 高温合金</li> </ol> </li> <li>二、 陶瓷       <ol style="list-style-type: none"> <li>1、 氧化物陶瓷</li> <li>2、 非氧化物陶瓷</li> </ol> </li> <li>三、 碳</li> <li>四、 聚合物       <ol style="list-style-type: none"> <li>1、 热固性树脂</li> <li>2、 热塑性树脂</li> </ol> </li> </ol> <p><b>第四章 复合材料增强相</b></p> <ol style="list-style-type: none"> <li>一、 复合材料增强相的特点</li> </ol>

- 二、晶须
- 三、颗粒
- 四、纤维

## 第五章 复合材料的复合理论和设计

- 一、复合材料的增强机制
  - 1、颗粒增强复合材料的增强机制
  - 2、纤维增强复合材料的增强机制
- 二、复合材料的复合法则—混合定律
  - 1. 混合定律
  - 2. 连续纤维增强复合材料
  - 3. 短纤维增强复合材料
- 三、复合材料设计

## 第六章 金属基复合材料 (MMC)

- 一、金属基复合材料概述
  - 1、金属基复合材料的分类
  - 2、金属基复合材料的研究特点
- 二、金属基复合材料的制备工艺
  - 1、金属基复合材料的制备工艺概述
  - 2、先驱(预制)丝(带、板)的制备
  - 3、固态法(连续增强相金属基复合材料的制备工艺)
  - 4、液态法(非连续增强相金属基复合材料的制备工艺)
  - 5、粉末冶金法(非连续增强相金属基复合材料的制备工艺)
  - 6、原位(in situ)生长(复合法)
- 三、金属基复合材料的界面和界面设计
  - 1、金属基复合材料的界面
  - 2、金属基复合材料的界面结合
  - 3、金属基复合材料的界面残余应力
- 四、金属基复合材料的性能
  - 1、金属基复合材料的一般性能特点
  - 2、纤维增强金属基复合材料的性能
  - 3、颗粒、晶须增强金属基复合材料的性能

## 第七章 复合材料的应用和发展

- 一、复合材料的应用
  - 1. 聚合物基复合材料的应用
  - 2. 金属基复合材料的应用
  - 3. 陶瓷基复合材料的应用
  - 4. 碳碳复合材料
- 二、复合材料的发展
  - 1、复合材料的性能对比
  - 2、复合材料的发展趋势

### 教学进度:

- 绪论 (4 学时)
- 复合材料界面 (2 学时)
- 复合材料基体 (4 学时)

	<p>复合材料增强相 (2 学时)          复合材料的复合理论和设计 (2 学时)          金属基复合材料 (MMC) (10 学时)          非金属基复合材料 (4 学时)          复合材料的应用和发展 (4 学时)</p>
<p>*教学大纲 (English) Syllabus</p>	<p>(须与中文一致, 翻译请力求信达雅。)</p> <p>Chapter one introduction</p> <ol style="list-style-type: none"> <li>1、 Research significance of composite materials</li> <li>2、 Development history of composite materials</li> <li>3、 Overview of composite materials</li> </ol> <ol style="list-style-type: none"> <li>1. Definition of composite materials</li> <li>2. Characteristics of composite materials</li> <li>3. Basic structural mode of composite materials</li> </ol> <ol style="list-style-type: none"> <li>4、 Key points and requirements of the course</li> </ol> <p>Chapter II composite interface</p> <ol style="list-style-type: none"> <li>1、 Interface of composite materials</li> <li>2、 Compatibility of composite materials</li> <li>3、 Interface theory of composite materials</li> <li>4、 Interface bond strength</li> <li>5、 Interface residual stress</li> </ol> <p>Chapter III composite matrix</p> <ol style="list-style-type: none"> <li>1、 Metal</li> <li>1. Aluminum, magnesium and their alloys</li> <li>2. Titanium and its alloys</li> <li>3. Superalloy</li> <li>2、 Ceramics</li> <li>1. Oxide ceramics</li> <li>2. Non oxide ceramics</li> <li>3、 Carbon</li> <li>4、 Polymer</li> <li>1. Thermosetting resin</li> <li>2. Thermoplastic resin</li> </ol> <p>Chapter IV composite reinforcement phase</p> <ol style="list-style-type: none"> <li>1、 Characteristics of reinforced phases of composite materials</li> <li>2、 Whisker</li> <li>3、 Granule</li> <li>4、 Fiber</li> </ol> <p>Chapter 5 composite theory and design of composite materials</p> <ol style="list-style-type: none"> <li>1、 Strengthening mechanism of composite</li> <li>1. Strengthening mechanism of particle reinforced composite</li> <li>2. Strengthening mechanism of fiber reinforced composite</li> <li>2、 Composite law of composite materials -- mixing law</li> <li>1. Mixing law</li> <li>2. Continuous fiber reinforced composite</li> <li>3. Short fiber reinforced composite</li> <li>3、 Composite design</li> </ol> <p>Chapter VI metal matrix composite (MMC)</p> <ol style="list-style-type: none"> <li>1、 Overview of metal matrix composites</li> <li>1. Classification of metal matrix composites</li> <li>2. Research characteristics of metal matrix composites</li> <li>2、 Preparation technology of metal matrix composite</li> <li>1. Preparation technology of metal matrix composite</li> <li>2. Preparation of precursor (preformed) wire (strip, plate)</li> <li>3. Solid state method (preparation process of continuous reinforced phase metal matrix composite)</li> <li>4. Liquid method (preparation process of metal matrix composite with discontinuous</li> </ol>

	<p>reinforcement phase)  5. Powder metallurgy (preparation process of metal matrix composite with discontinuous reinforcement phase)  6. In situ growth (composite method)  3、 Interface and design of metal matrix composite  1. Interface of metal matrix composite  2. Interface bonding of metal matrix composites  3. Interface residual stress of metal matrix composite  4、 Properties of metal matrix composites  1. General properties of metal matrix composites  2. Properties of fiber reinforced metal matrix composites  3. Properties of metal matrix composites reinforced by particles and whiskers  Chapter 7 application and development of composite materials  1、 Application of composite materials  1. Application of polymer matrix composites  2. Application of metal matrix composite  3. Application of ceramic matrix composite  4. Carbon carbon composite  2、 Development of composite materials  1. Performance comparison of composite materials  2. Development trend of composite materials  Teaching progress:  Introduction (4 class hours)  Composite interface (2 class hours)  Composite matrix (4 class hours)  Composite reinforced phase (2 class hours)  Composite theory and design of composite materials (2 class hours)  MMC (10 class hours)  Nonmetallic matrix composite materials (4 class hours)  Application and development of composite materials (4 class hours)</p>
<p>*课程要求  (中文)  Requirements</p>	<p>(课程考核方式、考核标准等; 不少于 50 字)  课堂学习出勤 (10%)、实验操作与小作业 (40%) 与期末论文 (50%)</p>
<p>*课程要求  (English)  Requirements</p>	<p>(须与中文一致, 翻译请力求信达雅。)  Class attendance (10%), experiment operation and homework (40%) and final paper (50%)</p>
<p>*课程资源  (中文)  Resources</p>	<p>(教材、教参、网站资料等。)  1. Polymer blends and composites by Manson, John A., New York : Plenum Press, 1976  2. The theory of composites by Milton, Graeme Walter New York : Cambridge University Press, 2001.  3. Handbook of ceramics and composites by Cheremisinoff, Nicholas P. New York : M. Dekker, 1990  4. Metal matrix composites. by Society of Automotive Engineers Warrendale, PA : Society of Automotive Engineers, 1994  5. Introduction to metal matrix composite materials. by Schoutens, Jacques E., Tempo, Kaman. Santa Barbara, Calif. : MMCIAC, 1982  6. 陶瓷基复合材料导论 贾成厂, 李汶霞, 郭志猛, 赵军 冶金工业出版社, 1998  7. 复合材料 吴人洁 天津大学出版社, 2000  8. 先进复合材料 鲁云, 朱世杰, 马鸣图, 潘复生 机械工业出版社, 2004  9. 复合材料的结构与性能 邹祖诤&lt;美&gt;, 吴人洁 科学出版社, 1999</p>
<p>*课程资源  (English)  Resources</p>	<p>(须与中文一致, 请力求信达雅。)  1. Polymer blends and composites by Manson, John A., New York : Plenum Press, 1976  2. The theory of composites by Milton, Graeme Walter New York : Cambridge University Press, 2001.  3. Handbook of ceramics and composites by Cheremisinoff, Nicholas P. New York : M. Dekker, 1990  4. Metal matrix composites. by Society of Automotive Engineers Warrendale, PA : Society of Automotive Engineers, 1994  5. Introduction to metal matrix composite materials. by Schoutens, Jacques E., Tempo, Kaman. Santa Barbara, Calif. : MMCIAC, 1982</p>

	6. Introduction to ceramic matrix composite materials: Jia Chengchang, Li Wenxia, Guo Zhimeng, Zhao Jun Metallurgical Industry Press, 1998 7. Composite material Wu Renjie, Tianjin University Press, 2000 8. Advanced composite materials Lu Yun, Zhu Shijie, Ma mingtu, Pan Fusheng Mechanical Industry Press, 2004 9. Structure and properties of composite materials Zou zuhui Science Press, 1999
备注 Note	