北京理工大學
BEIJING INSTITUTE OF TECHNOLOGY

Beijing Institute of Technology
Emerging Technologies in Materials for Renewable Engergy Program
1st July to 27th July, 2024
4 credits

NO.	Course	Teaching Hours	Course Description
1	电化学基础、能量转化的代表性反应及系能源材料表征 Electrochemical Fundamental, Representative Energy Conversion Reactions & Characterization of Renewable Energy Materials	12	本部分将通过4次课（含实验）介绍新能源材料所涉及的电化学基础知识（电解池、原电池的概念与所含电极的定义，电迁移、电泳等现象，可逆电池电势，电极电势，超电势等概念），代表性的能量转化反应如氧气还原反应、析氧反应，新能源材料的表征方法（X射线衍射、电子显微镜等）。 This section will introduce the fundamental electrochemical knowledge related to renewable energy materials through 4 lectures (including lab practice). The topics covered will include concepts such as electrolyzer, battery, and the definition of electrodes involved. Additionally, it will introduce phenomena like electron migration, electrophoresis, reversible cell potential, electrode potential, and concepts related to overpotential. Representative energy conversion reactions, such as the oxygen reduction reaction and oxygen evolution reaction, will be discussed. The characterization methods for renewable energy materials, such as X-ray diffraction and electron microscopy, will also be addressed.

2	氢能经济和氢能技术 Hydrogen economy and hydrogen technologies	12	本部分将通过4次课（含实验）介绍质子交换膜燃料电池（PEMFC）和质子交换膜电解水（PEMWE）的基本原理、研究和技术进展，包括关键部件材料，如质子交换膜材料、催化材料和气体扩散层等。此外，课程还将面向世界范围内的氢能经济远景，讨论PEMFC和PEMWE相较于其它技术路线的优势/劣势。最后，本课程还将针对不同地域和应用场景，讨论氢能经济的未来发展。 The basics and technological advances of proton exchange membrane fuel cell (PEMFCs) and water electrolysis (PEMWE) will be introduced and discussed in detail within 4 lectures (including lab practice), including the key materials, such as the proton exchange membrane, catalysts and gas diffusion materials, etc. Besides, these technologies will be compared with other energy conversion technologies in the context of hydrogen-economy for different countries worldwide. In the end, the future of the hydrogen-economy will be discussed based on the territorial features and application scenarios.
3	扣式锂电池组装及电化学测试 Coin-Type Lithium Battery Assembly and Electrochemical Measurements	12	本部分将通过4次课（含实验）系统介绍锂离子电池的工作原理、结构组成、电极制备、电池组装与电池测试等基础知识；而后结合实验案例介绍实验室扣式锂电池相关设计理论与组装过程，并通过常规电化学测试分析方法分析电池基本性能。 The part will introduce the working principle, structural component, electrode preparation, battery assembly, battery testing and other basic knowledge of lithium-ion batteries within 4 lectires (including lab practice); then combined with the experimental case to introduce the battery design theory and assembly process of the coin-type lithium battery, and further analyze the battery performance by using conventional electrochemical measurements.

4	光伏器件及材料，理论与实践 Photovoltaic Device and Key Materials, Theory and Practice	12	本部分将通过4次课（含实验）介绍光伏器件的发展历程以及各类光伏器件的材料组成和生产制备工艺；着重讲解光伏材料中的关键概念，如光谱类型、光电效应、Shockley–Queisser极限等，让学生掌握光伏器件的基本原理，可以分析其影响因素，知道光伏器件的测试原理、测试方法、测试参数，知道如何评估光伏器件的性能。此外，介绍新能光伏材料，如有机太阳能电池、染料敏华太阳能电池、量子点太阳能电池和钙钛矿太阳能电池的材料发展、器件结构设计、体系优缺点等，让学生了解相关领域的关键进展，明晰其经济效益。 This section introduces the historical development of photovoltaic devices, along with the material composition and production processes of various types of photovoltaic devices within 4 lectures (including lab practice). It focuses on key concepts in photovoltaic materials, such as solar spectrum, photoelectric effects, and the Shockley – Queisser limit, aiming to equip students with a basic understanding of the principles underlying photovoltaic devices. The content includes the analysis of influencing factors, knowledge of testing principles, methods, and parameters, and an understanding of how to assess the performance of photovoltaic devices. Additionally, the study explores new photovoltaic materials, such as organic solar cells, dye-sensitized solar cells, quantum dot solar cells, and perovskite solar cells, covering material development, device structure design, and the advantages and disadvantages of each system. This provides students with insights into key developments in the field and a clear understanding of their economic benefits.

5	汉语与中华文化体验 Chinese Language and Chinese Culture	16	汉语课程主要面相零起点学生，通过汉语拼音、基础汉字以及基本日常交流用语的教学，培养零起点学习者运用汉语进行交际的能力；同时在汉语教学外融入中华民俗体验课程，感知传统文化的魅力；并带领学生走出校园，参访名胜古迹，多元感知中国传统与现代的结合，体验魅力多彩的中国生活。 The Chinese language coarse is designed for students learning Chinese from scratch. Through the teaching of Hanyu Pinyin, basic Chinese characters, and essential daily communication phrases, this course aims to develop the communicative skills of beginners. Simultaneously, it incorporates Chinese folklore experiences into the curriculum, allowing students to appreciate the allure of traditional culture. Additionally, it takes students beyond the campus to explore historic landmarks in Beijing, providing a diverse perspective on the fusion of traditional and modern China and offering a firsthand experience of the vibrant and colorful life in China.