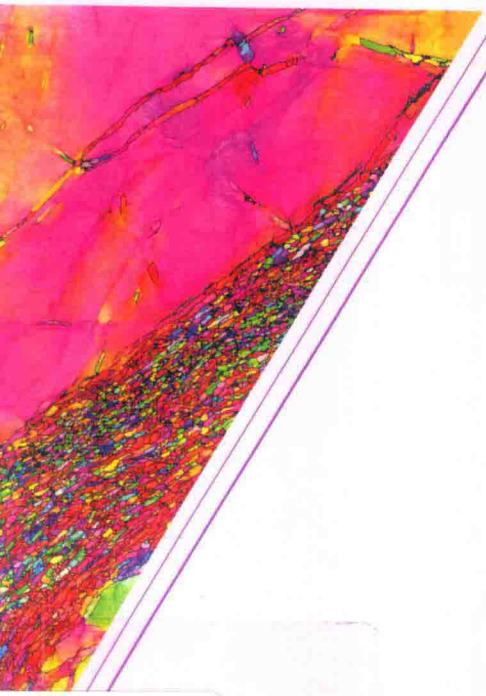
大学专门用途英语系列教材

English for Material Science

材料科学英语



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前言

根据《大学英语教学指南》的精神，大学英语的课程体系主要由通用英语、专门用途英语和跨文化交际三大类课程组成。

大学专门用途英语系列教材充分体现《大学英语教学指南》的精神，在大学英语教学改革实践的基础上，以培养与专业英语相关的英语能力为目标，将特定的学科内容与英语语言学习相结合，兼顾语言输入与输出训练，帮助学生实现在英语语境下对学科知识的有效输出和应用。

大学专门用途英语系列教材依据以内容为依托的教学理念编写，具有时代感、知识性和实用性。教材所选内容反映学科主线，体现相关学科的基本知识和前沿信息，兼具专业性和可读性。基于课文内容设计的阅读理解、专业词汇和学术英语词汇练习，帮助学生在理解课文的同时掌握文章中重要词汇，同时注重活学活用和适度扩展。此外，教材还提供设计灵活、注重实效的思辨训练和学术技能训练，帮助学生在实践中提高思辨能力、习得学术规范、培养学术研究能力，从而能够有效、得体地使用英语进行学业学习与学术交流。

大学专门用途英语系列教材能满足学生专业发展的需要，同时保证他们在大学期间的英语语言水平稳步提高。丰富的教学内容和多样的练习形式也为实现分类教学和因材施教提供可能，教师可根据实际需要选择教学内容，制定个性化的教学方案。

大学专门用途英语系列教材的编者们恳请使用者对本书中出现的问题提出宝贵意见和建议，以便再版时改进。

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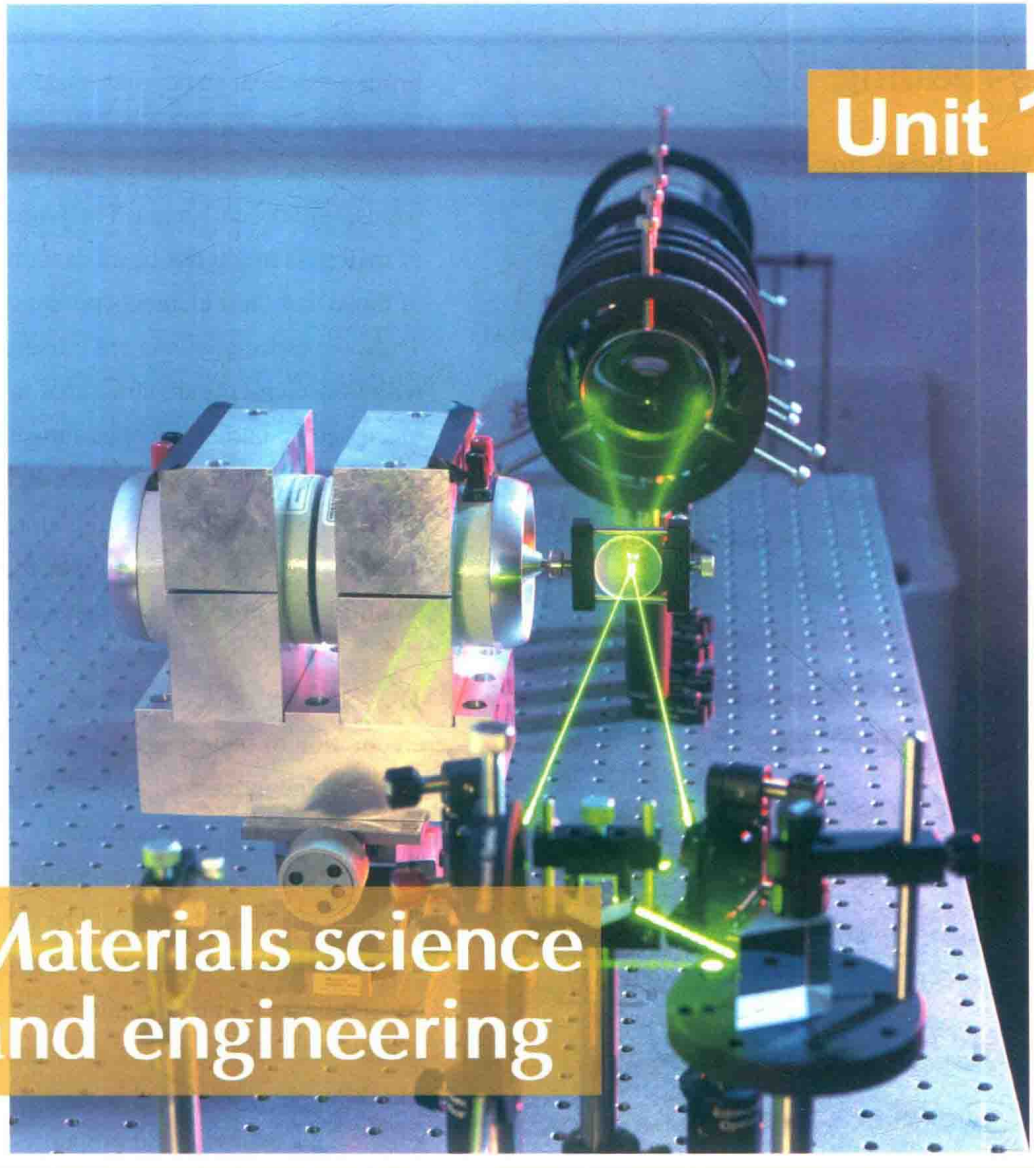
Contents



Unit 1

Materials science and engineering

In this unit, you will learn:

- **Subject-related knowledge:** The history and major concerns of materials science
  Materials engineering and engineers
- **Academic skill:** Searching for information
- **Reading strategy:** Dealing with unknown words (Part I)

Section A

Pre-reading

1 Study the six groups of materials in the right column and try to match them with the corresponding ages listed chronologically in the left column.

Age	Material
Stone Age	high strength alloys
Bronze Age	iron (powered) ore
Iron Age	copper, tin
Steel Age	special rocks, wood, bones, fur
non-ferrous & polymer age	aluminum, titanium, nickel, silicon, plastics, composites
exotic materials age	nanomaterials, biomaterials

2 Discuss the following questions in groups.

1. What are materials according to your understanding?
2. What do you know about the classification of materials?
3. Try to list five commonly encountered engineering materials.

1 From a practical standpoint, material objects are essentially substances that humans use to build things, including solids, liquids, and gases. The properties of materials might not be an exact image of those that their elements possess. Thus, we especially concern ourselves with how elements are structured in macroscopic bodies, what treatments are used during the elaboration of materials, or the physicochemical aggregation of different elements – all activities that condition the properties of materials.

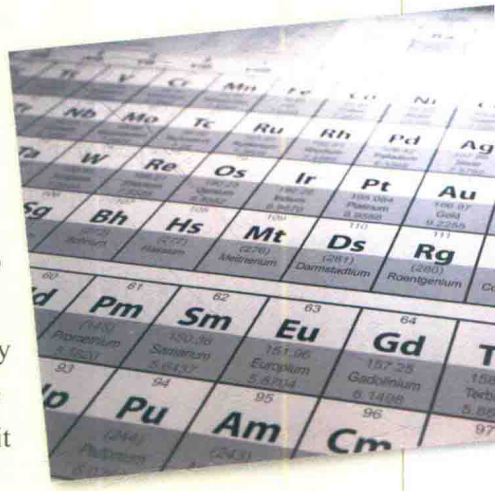
2 The selection, modification, and elaboration of materials to satisfy our needs merge in the foundations of human culture. From the very beginnings of prehistory, humans have manipulated substances so that they would be more useful. To create more useful materials, our forebears wanted to understand and control the composition of materials, and they often succeeded in modifying a material's behavior and properties and in predicting the effects of such manipulations.

3 This task developed over time, beginning as a handicraft that employed empirical and speculative knowledge. The history of materials science and engineering had already begun in the Stone Age

An introduction to materials science

Text A

when stones, wood, clay, and leather began to be manipulated. In the Bronze Age, mankind discovered the value of temperature and used it to modify materials by thermal treatments or by adding other substances. Yet, in spite of technological improvements, materials science remained empirical until the end of the 19th century. Materials science, as we now understand it, began with the appearance of Mendeleev's periodic table.



4 Since that time, some properties of elements that are related to their position in the periodic table began to be explained scientifically. Since the end of the 19th century, the introduction of chemistry, physics, calculus, and modern experimentation has brought the use and profits of materials to a mature status. Currently, thanks to more reliable knowledge of the structure of matter, we can design new materials atom by atom to achieve the properties we want. At last we would have materials that not only satisfy our requirements, but also permit us to create new ones that were hitherto unthinkable.

5 Thanks to this science, we can even speculate about using new, alternative materials to solve socioeconomic problems by avoiding the decimation of natural resources or trying to reach long-range sustained economic development. Conversely, the solution of unsolved problems improves our theoretical knowledge as well as the scope of materials in science and engineering.

6 In this context, materials scientists must analyze how the structure and composition of materials relate to their properties, and the effect of the method

of preparation of a material. Materials engineers examine the preparation, selection, and application of materials in agreement with known and desired properties. Engineers also incorporate technical and structural analysis and examine key concerns: energetic, economic, ecological, aging, etc.

7 For materials science and engineering, changes in physicochemical properties in response to a stimulus are highly significant. These properties can be classified into groups according to the kind of stimulus: mechanical, thermal, electromagnetic, chemical, and scattering.

8 In brief, mechanical properties, such as deformation and fracture, among others, are responses to applied mechanical forces. Thermal properties, like thermal conductivity and heat capacity, are affected by heat fluxes or temperature changes. Electrical properties such as the dielectric constant or conductivity occur in response to electromagnetic fields. Magnetic properties, like different types of magnetism, are also a response to electromagnetic fields. In a similar sense, optical properties, such as the refractive index or absorption, among others, respond to electromagnetic fields having high frequency. Chemical properties, like the chemical affinity, are responses to the existence of reagents in the environment. And the scattering properties are responses to the impact of particles depending on the material's structure.

9 In thinking about properties as a response to determined stimuli, we can group materials into families that facilitate a common analysis to determine the origin of the properties. For example, materials can be classified according to their electrical properties; hence, there are good or poor electrical conductors. This brings us to a taxonomy that permits us to see common features among materials in a family, to understand the basis of a property, and to predict the origin of new materials.

10 In the selective process of materials engineering, the choice of material is limited by the required properties and the available budget. The requisite properties are imposed by what we wish to make from the material, by

environmental conditions, and by the degradation of the material. In this selection, we have to take into account that the usage of materials and environmental conditions will provoke their degradation, which determines the required properties in an environment. When environmental conditions can be controlled, material selection is defined by its usage and the budget. That is, the economy plays a key role in materials engineering.

11 Materials science itself tries to analyze phenomena by the usual activities of contemporary science, and, without relying on economic aspects, to determine how structure, the presence of impurities and defects, production, purification, or mechanical transformation affects material properties.

12 Materials science can also do the converse: As desirable properties are defined, the material that can display them, although it might not exist in nature, is designed. There are well-known examples of this: stainless steel, powders used in metallurgy, ceramic materials with a controlled coefficient of expansion (which can even be zero), conducting plastics, plastics with a high resistance to friction, such as the one used in some aircraft radomes (a word formed from radar dome), or glasses with a saturable transmission coefficient.

13 The continuous development of new materials has also prompted the growth of an innovative industrial sector whose products, such as microelectronics or photonics, have greatly transformed the relationship between humans and their environment. Suffice it to say that with the many appliances that are electronically controlled, with the computer industry, with the substitution of copper by optical fibers in telephone conductors, or with satellite communications, we are challenged to make sense of the socioeconomic impact that these changes imply. Countries need to modify their industrial structure so they can survive the modifications that the new materials technology generates.

New words and expressions

macroscopic /ˌmækrəʊˈskɒpɪk/ *adj.*
large enough to be seen and examined without the aid of magnifying equipment 肉眼可见的；宏观的

elaboration /ɪˌlæbəˈreɪʃən/ *n.*
the process of improving and refining sth. 加工

clay /kleɪ/ *n.* 黏土

thermal /ˈθɜːməl/ *adj.*
relating to heat 热的；热量的

Mendeleev's periodic table 门捷列夫元素周期表

calculus /ˈkælkjʊləs/ *n.* 微积分

decimation /ˌdesɪˈmeɪʃən/ *n.*
the killing or destruction of a large population of a group or species 毁灭；削减

stimulus /ˈstɪmjʊləs/ *n.*
sth. that makes sth. or someone move or react 刺激；刺激物

electromagnetic /ɪˌlektrəʊmægˈnetɪk/ *adj.*
电磁的

scattering /ˈskætərɪŋ/ *adj.* 散射的

deformation /ˌdiːfɔːˈmeɪʃən/ *n.*
a change in the shape or form 变形

fracture /ˈfræktʃə(r)/ *n.*
a break, split, or crack in an object or a material 折断；断裂

conductivity /ˌkɒndʌkˈtɪvətɪ/ *n.*
the ability to allow electricity, heat, etc. to travel along or through 传导性

flux /flʌks/ *n.*
a flow or discharge 流量；流出

dielectric constant 介质常数

magnetism /ˈmægnɪtɪzəm/ *n.*
the physical force that makes two metal objects pull towards each other or push each other apart 磁性；磁力

optical /ˈɒptɪkəl/ *adj.* 光学的

refractive /rɪˈfræktɪv/ *adj.* 折射的

reagent /riːˈeɪdʒənt/ *n.*
a substance that shows that another substance in a compound exists, by causing a chemical reaction 试剂

taxonomy /tækˈsɒnəmɪ/ *n.*
the system of organizing things into different groups that show their natural relationships, esp. plants or animals （动植物等的）分类学

degradation /ˌdegrəˈdeɪʃən/ *n.*
the process of changing to a simpler form 分解；降解

impurity /ɪmˈpjʊərətɪ/ *n.*
a substance of a low quality that is contained in or mixed with sth. else, making it less pure 杂质

metallurgy /meˈtælədʒɪ/ *n.* 冶金（学）

ceramic /sɪˈræmɪk/ *adj.* 陶瓷的；制陶的

coefficient /ˌkəʊɪˈfɪʃənt/ *n.* 系数

resistance /rɪˈzɪstəns/ *n.* 抗性；阻力

radome /ˈreɪdəʊm/ *n.* 天线罩；天线屏蔽器

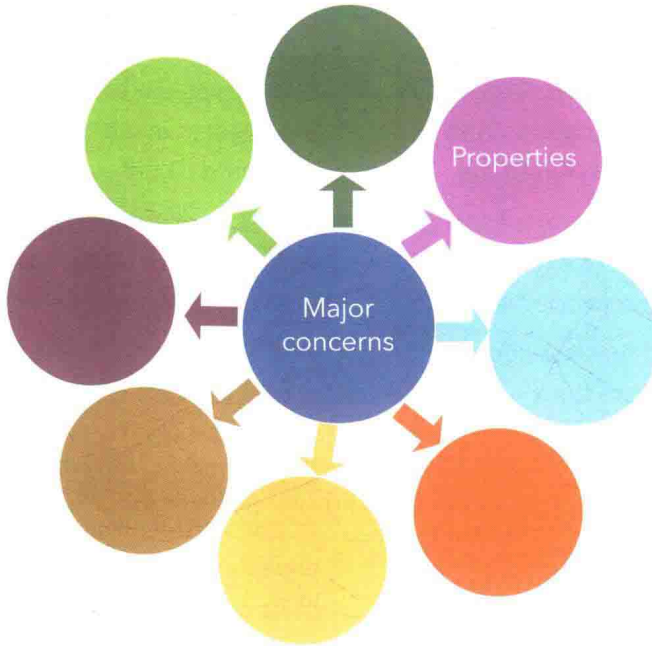
saturable /ˈsætʃərəbl/ *adj.*
capable of being saturated 能浸透的；可饱和的

microelectronics /ˈmaɪkrəʊɪˌlekˈtrɒnɪks/ *n.*
微电子学

photonics /fəʊˈtɒnɪks/ *n.* 光子学

Reading comprehension

1 Read Text A and fill in the following graph with major concerns of materials science and engineering.



2 Materials can be classified into five properties according to the kind of stimulus. Read Text A and write down the five properties of materials and find examples as many as possible.

Property of materials	Example

Language focus

1 The words in bold in Column A have different meanings in general English and English for materials science. Discuss with your partner and match them with their possible meanings in Column B.

Column A	Column B
___ 1. We especially concern ourselves with what treatments are used during the **elaboration** of materials.	A. the process in which particles are deflected or diffused
___ 2. They often succeeded in modifying a material's **behavior** and properties.	B. a number expressing a relation or property which remains the same in all circumstances, or for the same substance under the same condition
___ 3. These properties can be classified into groups according to the kind of stimulus: mechanical, thermal, electromagnetic, chemical, and **scattering**.	C. the process of developing sth. in further detail
___ 4. Electrical properties such as the dielectric **constant** or conductivity occur in response to electromagnetic fields.	D. a material or device that conducts or transmits heat or electricity, especially when regarded in terms of its capacity to do this
___ 5. Hence, there are good or poor electrical **conductors**.	E. the way in which a machine or natural phenomenon works or functions

2 Read the following paragraph and fill in the blanks with the common phrases in the field of materials science below.

materials paradigm　properties and performance
science and engineering　failure analysis

In recent years, materials science has become more widely recognized as a specific and distinct field of 1) _____. Many of the most pressing scientific problems humans currently face are the results of the limitations of available materials. Materials scientists emphasize understanding how the processing of a material influences its structure, and thus its 2) _____. This understanding of processing-structure-properties relationships is called the 3) _____. It is used to advance understanding in a variety of research areas, including nanotechnology,

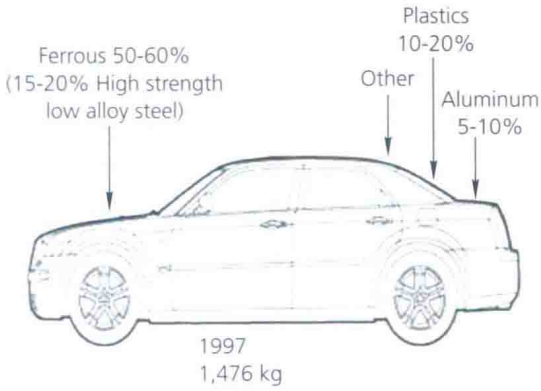
biomaterials and metallurgy. Materials science is also an important part of forensic engineering (法医工程) and 4) _____ – investigating materials, products, structures or components which do not function as intended, causing personal injury or damage to property.

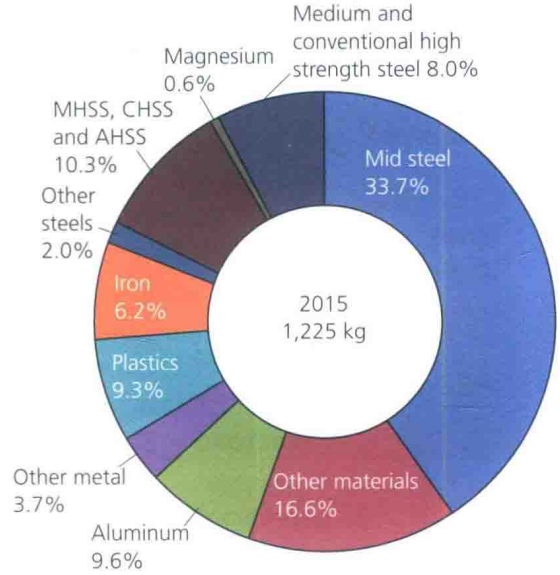
3 **Translate the following paragraph into English.**

人类对材料的选择通常可以定义一个时代，例如石器时代、青铜时代、铁器时代和钢铁时代等。现代材料科学源于冶金业，而冶金业源于采矿业和制陶业，所以说，材料科学是一门历史悠久的工程与应用科学。20世纪以来，材料科学已推动了多项技术的革新。例如，利用金属合金、硅及碳材料的特性来建造空间飞行器，从而实现对太空的探索。诸如塑料、半导体、生物材料等新技术，极大地方便了人类的生活，促进了工业的发展。同时，由于生活和工业的需求，材料科学本身也在不断发展。

Critical thinking

Materials scientists and engineers have to prepare for the constant changes in materials usage. Compare the two pictures and answer the following questions in groups.





1. Describe the changes of major materials used in producing an automobile in the U.S. from 1997 to 2015.
2. Give another example of changes of materials used in some manufactured products over a period of time.
3. What factors may motivate the development and application of new materials?

Researching task

Academic skill: Searching for information

Information can come from virtually anywhere – media, blogs, personal experiences, books, journal and magazine articles, expert opinions, encyclopedias, and web pages, etc.

1. Types of information

Type	Use
Magazine	• To find information or opinions about popular culture. • To find up-to-date information about current events. • To find non-scholarly articles about topics of interest within the subject of the magazine.
Academic journal	• To get help for your scholarly research. • To find out what has been studied on your topic. • To find bibliographies that point to other relevant research.
Database	• To find articles on specific topics. • To find online journals or news articles.
Newspaper	• To find editorials, commentaries, expert or popular opinions. • To find current local, national or world news.
Library catalog	• To find virtually any topic. • To find hard copies of current or back issue of journals, books, newspapers or magazines.
Website	• To find information from all levels of government – central to local. • To find expert or popular opinions. • To find information of various types of media, e.g. illustrations, audio and video information.

2. Searching for information

Author / Title search

Searching by author and / or title obviously assumes that you are searching for a particular author, book or article, probably in either a database or a library catalog. Here are some tips:

- When searching by author, put the author's last name first, e.g. "Kotler, Philip", not "Philip Kotler", if he is from an English-speaking country. Search the author's full name in Chinese order if he is a Chinese. Sometimes, the author could be an organization, so give the full name of the organization as it commonly appears, e.g. "World Bank".
- When searching by title, it helps if you enter the title as correctly as possible.

Keyword search

It is basically a way of searching through subject or topic. Most library catalogs and databases will include an option to search by keyword as an alternative to author and title. The first step of keyword search is to decide the key word(s) or phrase(s). Normally, the word(s) or phrase(s) which can cover the topic you search can be selected as keyword(s). A good research topic usually contains two or three concepts. For example, you need to write a paper on "The Impact of Cognitive Styles on Design Students' Spatial Knowledge". We can break the topic into concepts, like "cognitive styles" and "spatial knowledge", which can be used as keywords. Then type them in a search bar in a database, EBSCOhost for instance. In a database, there are usually two ways of search, i.e., basic search and advanced search.

Basic search (see Fig. 1) generates a large number of sources for you to differentiate, which is an exhausting task. But advanced search (see Fig. 2), which provides more choices for further conditioning, can make the work lighter. There are many variables that can be chosen to refine the search. And you can define the relationship between the keywords by choosing "and", "or" or "not" based on the results you intend to obtain.

Fig. 1 Basic search

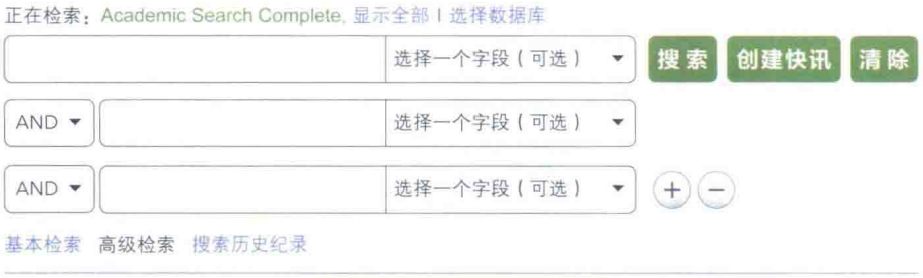


Fig. 2 Advanced search

As "cognitive styles" is a broader topic and "spatial knowledge" is more specific, they can be typed in the upper and middle search bars respectively. More relevant results will appear. You can then refine the search by selecting a specific variable. In this case, "subject"（主题语）can be chosen to filter the results (See Fig. 3).

Fig. 3

Snowball search

It is a good way if your topic has a key work or author. You can trace the citations of that author using a specialized citation database, such as the Social Science Citation Index to obtain other key works or authors. You will follow the stream of research up to the near present and see the way in which the work or the author has influenced the subsequent studies.