

Original Research Article

Cultivation of Instrumental Analysis Ability for Postgraduates Majoring in Materials Science and Engineering

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Abstract: Materials science and engineering, as a major of materials, mainly trains students to have professional abilities in the fields of metal materials science and engineering. The major has strong theoretical basic knowledge and humanistic feelings. The major of materials science and engineering mainly studies the composition, structure, processing technology, performance and application of materials. During the research tasks of graduate students, it is necessary to test the properties of materials, characterize the morphology and structure of materials, explore and analyze the formation and preparation mechanism of materials. According to the different research directions of materials, the use and requirements of experimental instruments are different. Therefore, setting up corresponding instrument analysis courses for graduate students majoring in materials and cultivating instrument analysis ability are the key links in the training of graduate students majoring in materials science and engineering.

Keywords: Materials Science and Engineering; Graduate Students; Instrument Analysis Ability

1. Introduction

The major of materials science and engineering mainly focuses on materials. According to the catalogue of disciplines for awarding doctoral and master's degrees and training graduate students issued by the Academic Degrees Committee of the State Council, it is clearly stated that materials science and engineering are the first-level disciplines in engineering disciplines, with three two disciplines, namely, materials science, materials physics and chemistry and materials processing engineering. There are many main research directions around materials science and engineering, for example, new energy materials, inorganic nonmetal materials, metal materials, polymer materials, wear-resistant and wear-resistant materials, nano-materials and functional devices, material processing, etc. With the continuous development of society, the specialty of materials science and engineering

has been continuously developed and optimized with the progress of society. The preparation, characterization and performance testing of materials are all inseparable from the technical support of instruments. Therefore, in the process of cultivating graduate students, it is necessary not only to cultivate students' theoretical knowledge. It is also necessary to train graduate students to master the corresponding instrument analysis ability, to freely use a variety of equipment for better research and testing of materials, to characterize the structure, properties and morphology of materials more scientifically, and to further study the formation and preparation of materials.

2. The significance of cultivating the instrument analysis ability of graduate students majoring in materials science and engineering

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doi: 10.18282/ims.v3i3.379

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The development of science and technology promotes the progress of human society. Exploring materials through science and technology is of great significance to the development of human society. In order to achieve better development in harmony with nature, human beings are constantly searching for more effective materials, optimizing the properties of materials, reducing the cost of materials and reducing the degree of damage to the natural environment, which is an important choice for human development in the long run. For example, new energy materials, high-strength polymer materials, degradable materials conducive to environmental development, shape memory alloy materials which are widely used in clinical medical fields, can be used in artificial bones, dental orthodontics and other applications, and biological materials which can be used for printing biological organs, etc. To optimize and upgrade applications in many fields, we need to master the design and preparation of new materials. The first task is to study the properties of materials, to have a clear understanding of their composition and corresponding structure, and to analyze and test materials in an all-round way. It is necessary for relevant researchers to have the corresponding analytical ability. For the research of materials, it is natural to rely on corresponding instruments and equipment. With the continuous optimization and development of materials science and technology, large-scale precision instrument analysis has become an important way of material structure research. Nowadays, the design and structure characterization of new materials need to be analyzed with the help of large-scale precision instruments and equipment. For example, scanning electron microscope and transmission electron microscope are needed to observe the morphology and structure of materials; X-ray diffractometer is used in the phase analysis of materials; Energy spectrometer used in element composition detection; X-ray photoelectron spectroscopy for elemental valence analysis, etc., therefore, the development of instrument analysis ability is also a crucial stage in the research level of graduate students majoring in materials science and engineering. With the national emphasis on personnel training and the innovation of education development, the state gives a lot of support to the education of graduate students. At the same time, the national and social requirements for the development of graduate students

have also been improved. Scientific research ability is also strict, which is the basic ability in the development of postgraduate training. For postgraduates majoring in materials science, instrumental analysis ability plays an important role in project research and plays a positive role in the smooth implementation of the project. Optimizing graduate students' instrumental analysis ability not only improves graduate students' scientific research level, but also contributes to their own employment development. And it will meet the development needs of society for precision instrument analysis talents. Therefore, the cultivation of instrument analysis ability of graduate students majoring in materials science and engineering can not only optimize the research quality of materials science and engineering, but also promote the development of disciplines and help the development of graduate students, which meets the development requirements of society for instrument analysis talents.

3. The existing problems in the cultivation of instrument analysis ability of graduate students majoring in materials science and engineering

Nowadays, with the development of society, the development of materials science and engineering specialty has been strengthened. In order to meet the demand for instruments and equipment in the development of materials science, many colleges and universities in China have set up instrument analysis courses in materials science specialty, such as instrument analysis and test methods of material analysis. There are some contradictions in the postgraduate study of instrument analysis courses, such as the need for centralized teaching in colleges and universities, and the limited conditions of hardware, equipment and facilities in schools. Instrumental analysis course is mainly set up in the first year of graduate students, but there is no teaching experiment course with corresponding hours in the first year. The experimental teaching course has fewer hours, and the students can practice the computer only a few times, which leads to the contradiction of graduate students' instrumental analysis study, that is, it is difficult for scholars to know and master the relevant knowledge of instrumental analysis in a short time, which leads to the poor development effect of graduate students' instrumental operation and analysis ability. Secondly, with the

continuous development of science and technology, the precision equipment involved in instrumental analysis has been continuously optimized and new, and the corresponding functions of instruments and equipment have been continuously increased. More advanced functions have been added to the instruments. For example, X-rays can be used to test the phase, but later they can be used to test the thickness of thin films or the particle size distribution of nanoparticles. However, in the teaching of instrumental analysis courses, it can't be updated in time with the development of the times, and there is often a lag in the curriculum, which makes the development of instruments unable to be understood by the students. It also transmits a lot of lagging information to the students, which causes a lot of questions to the students in the course of instrument analysis. Therefore, before optimizing the teaching of instrument analysis, the teachers should constantly optimize their reserves of related equipment knowledge. Teachers can't blindly "eat the old", and their teaching cognition and thoughts still remain in the past few years. Teaching according to the textbook cannot meet the development requirements of cultivating innovative and applied talents. In the major of materials science and engineering, there are many materials science majors involved, such as new energy, metal materials, non-metallic materials, polymer materials, etc. Instrumental analysis has different pretreatment and testing methods in different research fields and different research projects. Nowadays, in many domestic colleges and universities, there is still uneven development. Many colleges and universities do not pay enough attention to the course of instrument analysis, which often fails to provide students with corresponding learning opportunities because of the lack of instruments and equipment. Some colleges and universities even do not fully show the instrument analysis to students, such as spherical aberration transmission electron microscope, which is not available in some colleges and universities, and cannot be displayed in class during the course explanation. Many colleges and universities don't have scanning electron microscope, so the development of instrumental analysis course still stays in textbook teaching. Scientific research projects cannot be carried out in an orderly way, and the cultivation of graduate students' instrumental analysis ability has become an armchair strategist. Therefore, in the process of offering college courses, it is

necessary to fully guarantee the development of students' instrumental analysis ability in colleges and universities, ensure the introduction and smooth use of relevant analytical instruments and equipment, and provide corresponding foundation for the development of students.

4. Specific training measures of instrument analysis ability for material science and engineering graduate

4.1 To carry out research and develop different training programs for instrumental analysis

In the major of materials science and engineering, research is carried out on the instrument analysis and mastery required by graduate students in different subject directions and different subject groups in the process of project research. In the theoretical course of instrument analysis, the universal instrument analysis and the latest progress are mainly grouped according to different research directions in the process of experiment development, so as to cultivate the analytical ability of related instruments mastered by students more professionally and pertinently. After the students have mastered the basic theoretical knowledge of instrumental analysis, they will distinguish the cultivation of instrumental analysis ability of postgraduates with different professional research directions, mainly cultivate their instrumental analysis ability, and explore the mode of cultivating points of instrumental analysis ability of postgraduates majoring in materials.

4.2 To establish a new model of combining theoretical practice with data analysis

In the course of cultivating graduate students' instrumental analysis ability, three aspects should be combined, namely, the basic knowledge of materials science and engineering, students' computer operation and related specific applications. Therefore, when the course is offered, these three aspects should be closely combined and complement each other. Only when the three aspects are organically unified can the teaching significance of the course be fully realized. First, teachers who teach theory in colleges and universities should carry out large class teaching. Instructors give concentrated teaching explanations on the basic principles of instruments and

equipment required by various materials disciplines, in which the class hours should be guaranteed to be more than 10 class hours. Secondly, based on the university-level equipment sharing platform, corresponding analytical instruments can be provided, including the instruments and equipment for material structure characterization, performance test instruments and equipment, and special material preparation instruments. Finally, teachers responsible for equipment management should be set up to manage students' computer courses. Teachers can divide graduate students into groups and practice computer operation in batches, mainly to cultivate students' proficiency in instrument operation and students' application ability, and ensure that students' computer operation time is no less than four hours each time, and the samples used in computer operation should be frontal and typical. Students are agreed to bring their own samples, and special teachers should follow up the data and give corresponding guidance. It is necessary to focus on the matters needing attention in the process of instrument analysis and the use and test of various analysis software, and set up a large class teaching, mainly by means of demonstration, telling the rules of using analysis software, and ensuring one class hour for each type of instrument and equipment.

4.3 To actively advocate interdisciplinary training mode

With the development of science and technology, science and technology gradually tend to be diversified, and scientific research projects can be developed interdisciplinary. Postgraduates in materials disciplines should also master the instrumental analysis of organic chemistry, such as biochemical instruments and high performance liquid chromatography. The development of materials science and engineering majors also puts forward higher requirements for graduate students' instrumental analysis ability.

5. Conclusion

The cultivation of graduate students' instrument analysis ability promotes the development of materials science. Graduate students play an important role in the operation of instruments and the improvement of corresponding analysis ability, and contribute to the training of innovative and applied talents for the country and society.

References

1. Yang J, Zhu D, Ma X, *et al.* Research on the cultivation of experimental skills of postgraduate in instrumental analysis with the teaching according to students' aptitude. *Guangzhou Chemical Industry* 2018; 45(10): 261–262.
2. Liu H. Learning from foreign experience and reforming graduate teaching mode. *Experimental Technology and Management* 2017; 34 (5): 168–170.