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The Application Design of Manual Model Combined with Animation Demonstration in the Teaching of "Fundamentals of Materials Science and Engineering"-- Take "Delivery of Edge Motion Dislocation" as an Example

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Abstract: In this paper, the process of moving dislocation delivery in Fundamentals of Materials Science and Engineering is demonstrated through the combination of manual modeling with ultra-light clay and computer Flash animation.
Keywords: Manual model; Animation demonstration; Materials science and engineering; Basic multimedia dislocation motion

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1. Background

"Fundamentals of Materials Science and Engineering" is an important professional course for postgraduate entrance examination [1], which belongs to a typical knowledge subject category. This course focuses on explaining to students the relationship between the composition, structure and properties of materials and the law of change, with the goal of guiding the design and application of materials, and laying a solid foundation for learning follow-up professional courses, engaging in scientific research and engineering technology work. This course is a comprehensive interdisciplinary subject including thermodynamics, chemistry and engineering. It is a wide-caliber major with extensive and abstract application of basic theories [2-3]. Therefore, the traditional "five ones" that is, "one classroom, one blackboard, one chalk, one teacher, one book" classroom teaching mode has been difficult to meet the needs of students' knowledge mastery. This essentially raises the requirement of curriculum delivery. Only on the basis of traditional teaching mode, it is a scientific problem worth exploring to stimulate students' interest in this course and effectively master knowledge points.

The formation of dislocation is a common phenomenon in crystalline materials such as metals. In addition, the mechanical properties of the crystal such as strength, plasticity and fracture are also related to the motion of the dislocation. Especially for the delivery of motion dislocation, it is not easy to distinguish, and the geometric space imagination required to understand the relevant knowledge is strong. This shows that this part of the content is suitable to use a variety of teaching methods to fully mobilize the enthusiasm of students in vision, hearing, touch and other aspects. Using manual model as the carrier and combining with animation demonstration is a good teaching method that can be selected in this chapter.

2. The important role of manual model and animation demonstration in teaching.

2.1 Visual display of material structure: Manual model and animation demonstration can present abstract material structure to students in an intuitive and concrete form. Through the observation and operation of manual models, students can have a deeper understanding of the atomic structure of matter and the concept of crystal growth. To enable students to have a more thorough understanding of the basic principles of materials science.

2.2 Promote the development of students' observation and experiment skills: students can deepen their understanding of the

structure and properties of materials by making manual models, and at the same time exercise their observation and operation abilities in the process. At the same time, the animation demonstration can simulate the real experiment process, so that students can observe and analyze the phenomenon of animation experiment, so as to improve the ability of experiment design and data interpretation.

2.3 Enhanced interaction and participation: Students can explore material science knowledge through discussion, exchange and collaboration in the process of manual modeling. The animation demonstration can also stimulate students' interest and curiosity, and arouse their desire to explore.

3. Teaching practice and exploration

The motion part of the dislocation is a difficult part, and learning this part is challenging. Taking edge dislocation as an example, its dislocation line is perpendicular to each other with the Burgess vector. When two edge dislocation meet, there are two situations, namely, Burgess vector is perpendicular to each other and parallel to each other (Figure 1) , and the results produced after movement are also more complicated. Today, with the continuous progress of computer science, it can integrate text, animation and sound, etc., and achieve more functions. The application of this technology in teaching can strengthen the ability of knowledge transfer, make the teaching content scientific and interesting, and ultimately promote the improvement of teaching effect .

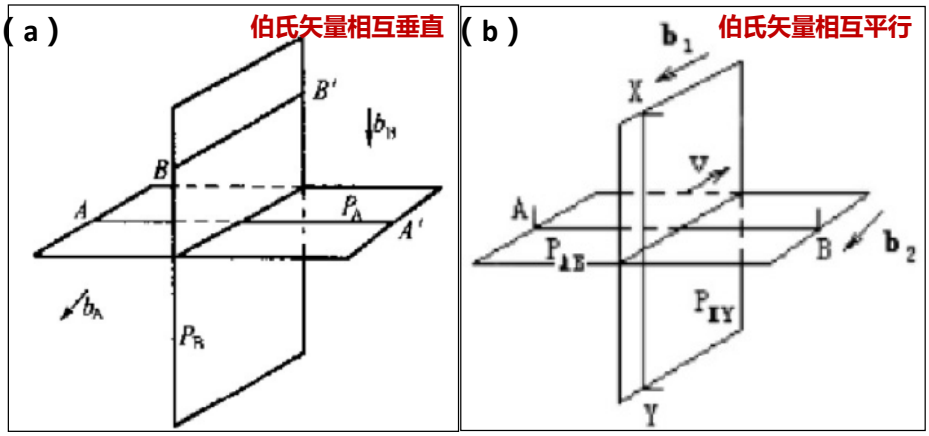

FIG. 1 Delivery of vertical dislocations (a) Perpendicular to each other and (b) parallel to each other

3.1 Teaching design of "Delivery of edge motion dislocation" assisted by animation demonstration

First of all, under the guidance of the introduction problem, three basic problems related to the edge dislocation are put forward, that is, what is the edge dislocation, the geometry of the dislocation and the use of the dislocation. This part belongs to the introduction part. Then enter the text description, through the animation demonstration, it is found that the atoms fly out in all directions, regular arrangement to form a crystal, and then dynamically produce the edge dislocation inside the crystal; The motion of vector color map in animation is used to simulate the change process of the shape and size of the dislocation line when the two dislocation lines intersect, and the direction of atomic motion when the dislocation is formed is repeatedly displayed. For the delivery of edge dislocation, some pictures in the animation are captured below, as shown in Figure 2.

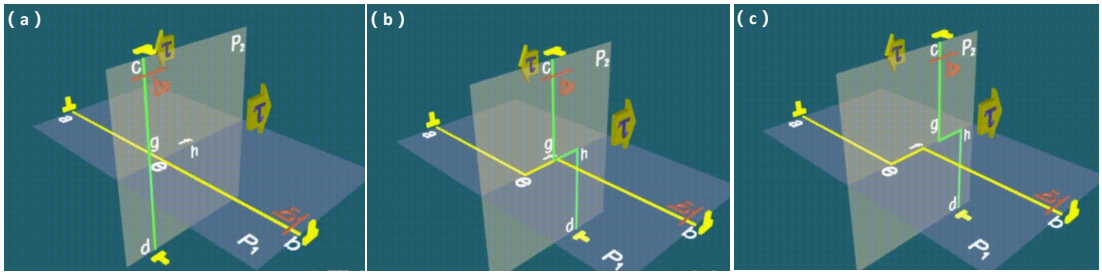

FIG. 2 Animation of two wrong motions of perpendicular Boehler vectors (a) initial state, (b) intermediate state, and (c) final state

Philosopher Marx said that "practice is the only criterion for testing truth", so hands-on operation, more intuitive training of students' three-dimensional spatial sense, manual model practice into the classroom, etc., will further strengthen students' understanding and memory of knowledge, to achieve twice the result with half the effort.

3.2 Design of manual model in practical teaching of "Delivery of edge motion Dislocation"

Practical teaching has the advantages of being intuitive. First, teachers can intuitively present teaching content with the help of manual model, and students can also intuitively accept the content in manual practice. In class, using easily available ultra-light clay as raw materials, we first built a model for the features of edge dislocation -- the Bergdahl vector and the dislocation line are

perpendicular to each other. Then, combined with the moving direction in animation, we observed the relative position and trace of the clay at the time of delivery by pulling the dislocation line and recorded it, which is conducive to mastering knowledge. Taking the delivery of two edge dislocation perpendicular to each other as an example, some photos were recorded when the manual model moved, as shown in Figure 3.

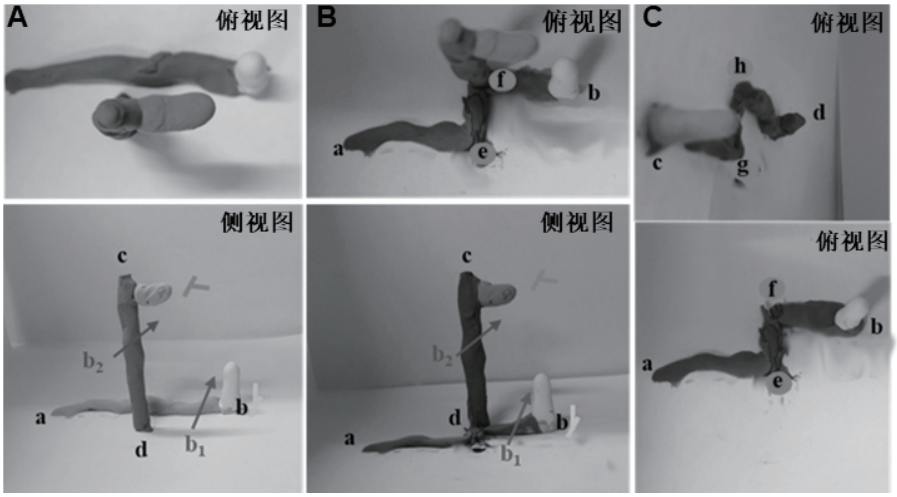

FIG. 3 Manual model of two-position motion of perpendicular Boehler vectors (a) initial state, (b) intermediate state, and (c) final state

The last part is the summary and extension, demonstrating the application of crystal dislocation in practice, echoing the beginning, and leaving the question at the end of the question - how is the state of the two Bodleian vectors parallel to each other after the dislocation settlement, stimulating the students' interest in continuous follow-up study.

In combination with the characteristics of the basic course of materials science, which is systematic and combines theory with practice, and "dislocation movement in crystals" is a difficult part of the course, various teaching methods should be used in the teaching process to provide students with good visual and auditory effects and inspire their imagination. In the comprehensive course teaching, images, animations and manual models are used to help students understand the process and results of crystal dislocation movement, and then acquire basic theoretical knowledge of crystal dislocation movement.

4. Concluding Remarks

Taking "the delivery of dislocation movement" in the course of "Fundamentals of Materials Science" as an example, animation demonstration and manual model are used to organically combine the dry theoretical knowledge with hands-on practice, enrich the classroom teaching content, and have strong pertinence and operability. To sum up, manual model practice and animation demonstration are of great significance to the teaching of "Fundamentals of Materials Science", enabling students to have a deeper understanding and application of the basic principles and concepts of materials science.

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