A collection of objects including a chessboard, medals, a compass, and glasses. The chessboard is in the top left, with several pieces visible. There are two medals: one with a red ribbon and a crown, and another with a blue ribbon and a star. A compass is in the bottom left. A pair of glasses is in the center. The background is a light-colored, textured surface.

Development of the Visualization and Simulation Models in Material Technology and Failures Related Courses

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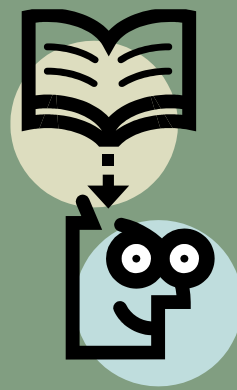
Contents



- Introduction
- Topics Covered in This Work
- Interface of the Animation Framework
- Development of the Animation
- Development of the Experimental Demonstration
- Summary



Introduction



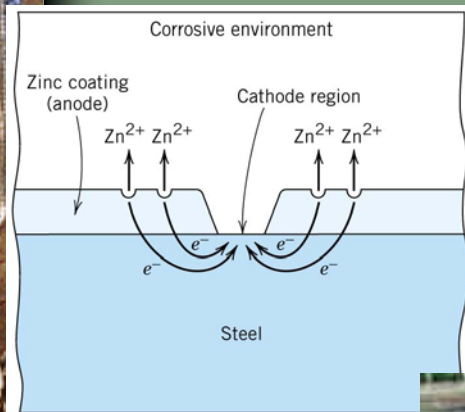
Tell me and I'll forget. Show me and I may remember. Involve me and I'll understand

- Advantages of visualization
 - Better understandings on the topic
 - Making the teaching materials easier and more interesting
 - Improving students' learning capabilities and attitude towards the course



Visual Tools in Teaching

Schematic Diagram



- Multi-media – use of more than one medium
- Traditional means: Figures, Pictures or Video
- Video and animation ~ most efficient means to demonstrate the actual phenomenon to the students

Picture



Installation of a
MATCOR SPL_{tm} -
ANODE using a
ditch witch

MATCOR

Video



Objectives

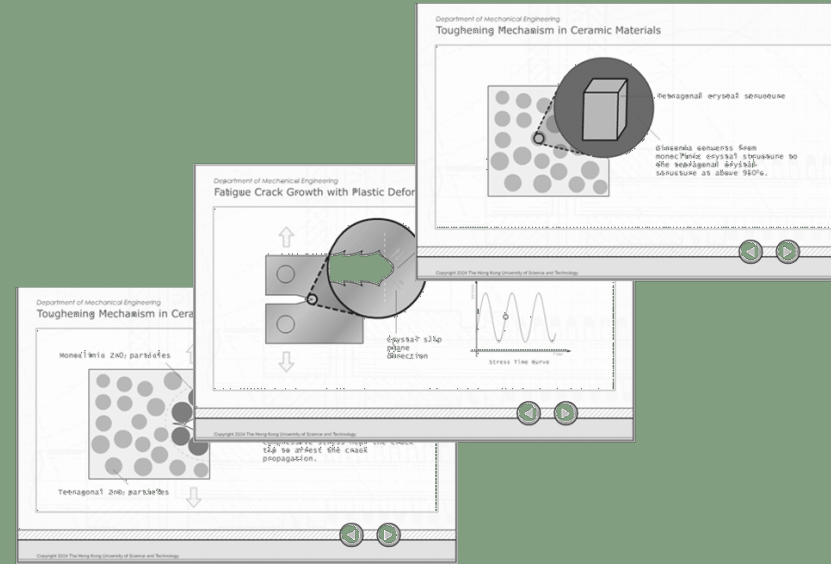


- To develop animations and experimental demonstrations to enhance the students' understandings
- Compatibility to the web components



Topics

- **Two courses**
 - MECH 242 Engineering Materials
 - MECH 301 Material Failure in Mechanical Applications
- **7 computer animations**
 - Tetrahedral atomic position and octahedral atomic position in ceramic material
 - Craze in polymers
 - Deformation in semicrystalline polymers
 - Transformation toughening mechanism in ceramic materials
 - Crevice corrosion in metal
 - Crack tip propagation under cyclic loading
 - Strengthening polymeric material by pre-tensioning



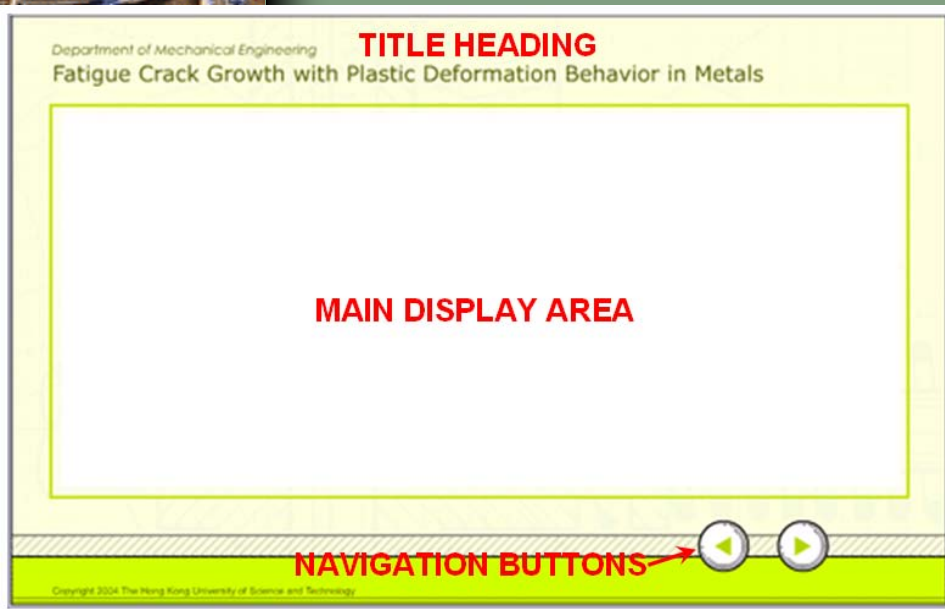
Topics



- **4 Experimental Demonstrations**
 - Strengthening polymeric material by pre-tensioning
 - Creep and Relaxation of polymers
 - Fracture behavior under the plane stress & plane strain conditions
 - Fatigue life experiment under various stress amplitudes on aluminum



Interface of the Animation Framework

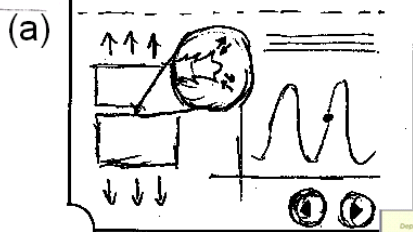
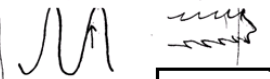


- Operated under MS Windows
- Advantages
 - Allowing students to choose the contents forward or backward
 - Sequentially present the content materials to students

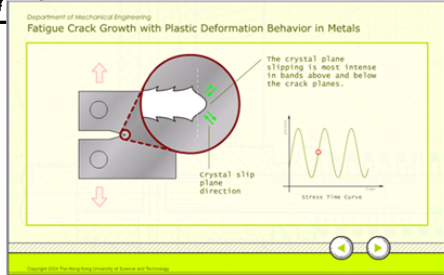


Development of the Animation

The crystal plane slipping is most intense in bands above and below the crack planes.



(b)

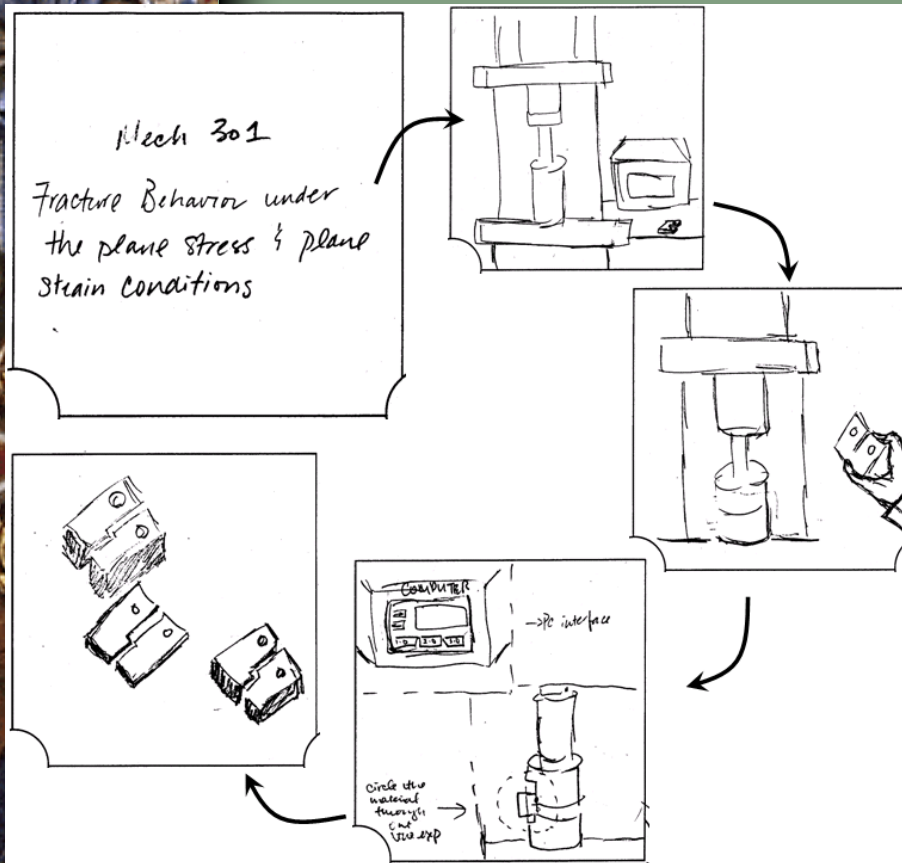


(c)

- 3 stages
 - Contents organization and conceptual design
 - Storyboard development
 - Fabrication of the computer animation
- Advantages in using Macromedia Flash
 - Small file size
 - Easy to be incorporated in the webpage



Development of the Experimental Demonstration



- 3 stages
 - Contents organization and conceptual design
 - Storyboard development
 - Fabrication of the video
- Digitalized for internet accessing



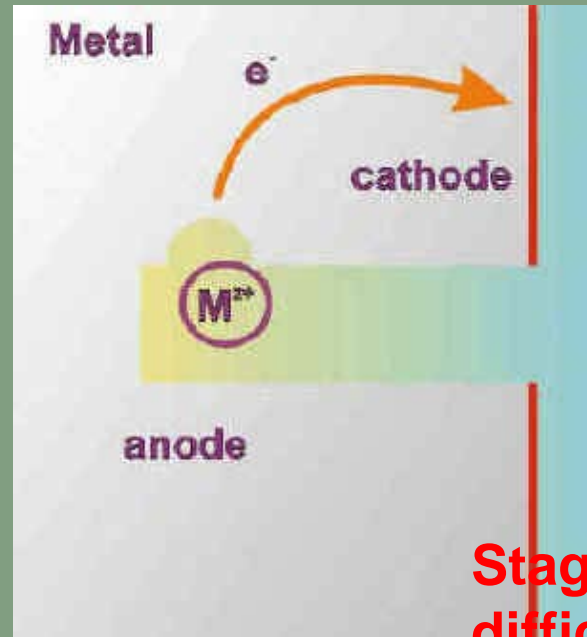
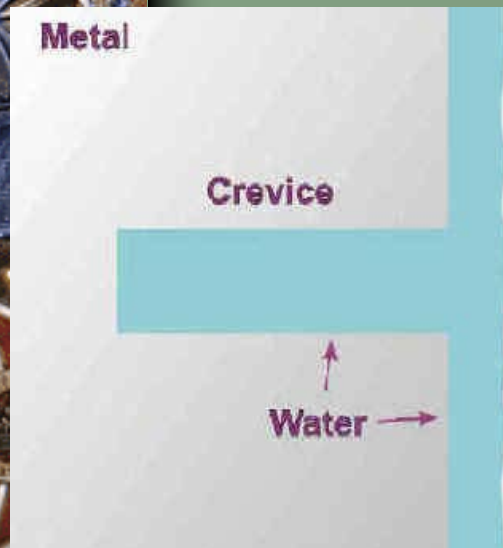


Examples



Example 1

Corrosion Form – Crevice Corrosion



Stage 1 The oxygen content in the water occupying a crevice is equal to the level of soluble oxygen and is the same everywhere

Stage 2 Because of the difficult access caused by the crevice geometry, oxygen consumed by normal uniform corrosion is very soon depleted in the crevice



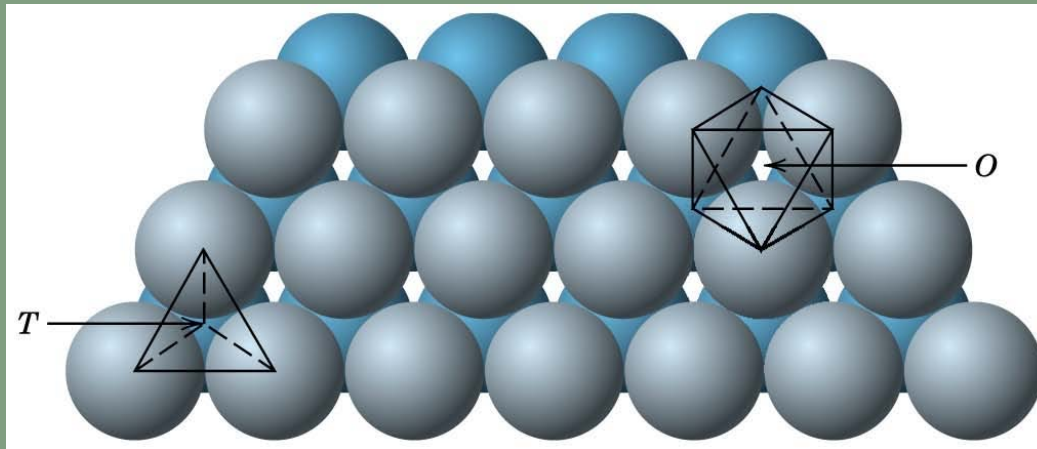
Crevice Corrosion – Flash Animation

The screenshot shows a Microsoft Internet Explorer browser window. The address bar displays the URL: http://ctz106.ust.hk/test/mech242/06_Crevise06.swf. The browser's menu bar includes options like '檔案(F)', '編輯(E)', '檢視(V)', '我的最愛(A)', '工具(T)', and '說明(H)'. The toolbar contains various navigation and utility icons. The main content area shows a Flash animation interface with a light green background. At the top, it reads 'Department of Mechanical Engineering' and 'Crevice Corrosion Mechanisms in Metals'. A central white box with a green border contains the text: '..... Objective', 'In this animation, you can understand the mechanisms of crevice corrosion.', and 'Click the 'Play' button to start'. Below this box are two circular navigation buttons: a left arrow and a right arrow. The bottom of the animation area features a green bar with the text 'Copyright 2004 The Hong Kong University of Science and Technology'. The browser's status bar at the bottom shows the system tray with the time '13:58' and the language 'EN'. The Windows taskbar at the very bottom includes the Start button and several open applications like 'Sham et...', '收件匣...', 'Jasc Pain...', and 'http://ctz...'. On the right side of the browser window, there is a vertical toolbar with various icons, including one for 'Office'.



Example 2

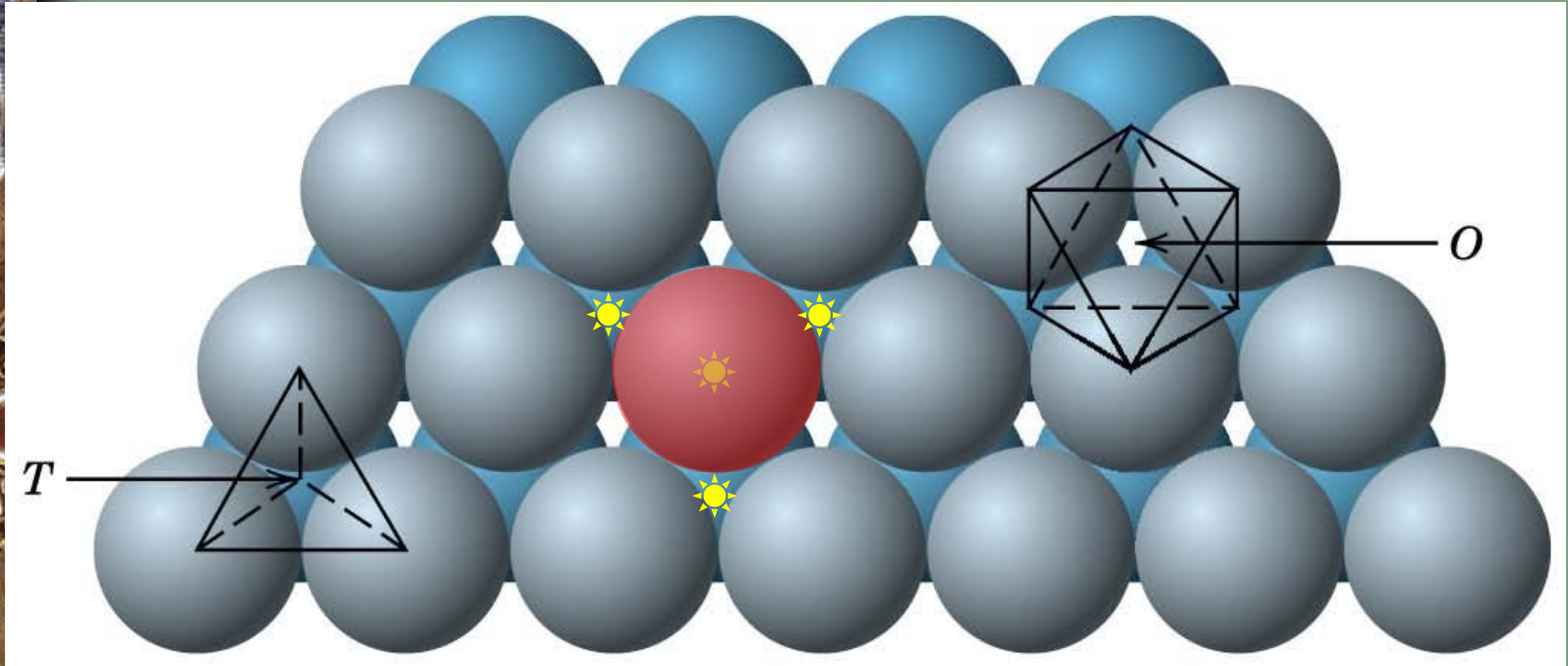
Crystal Structures from the Close Packing of Anions



- Tetrahedral Position: Four atoms surrounding one site
- Octahedral Position: Six atoms surrounding one site



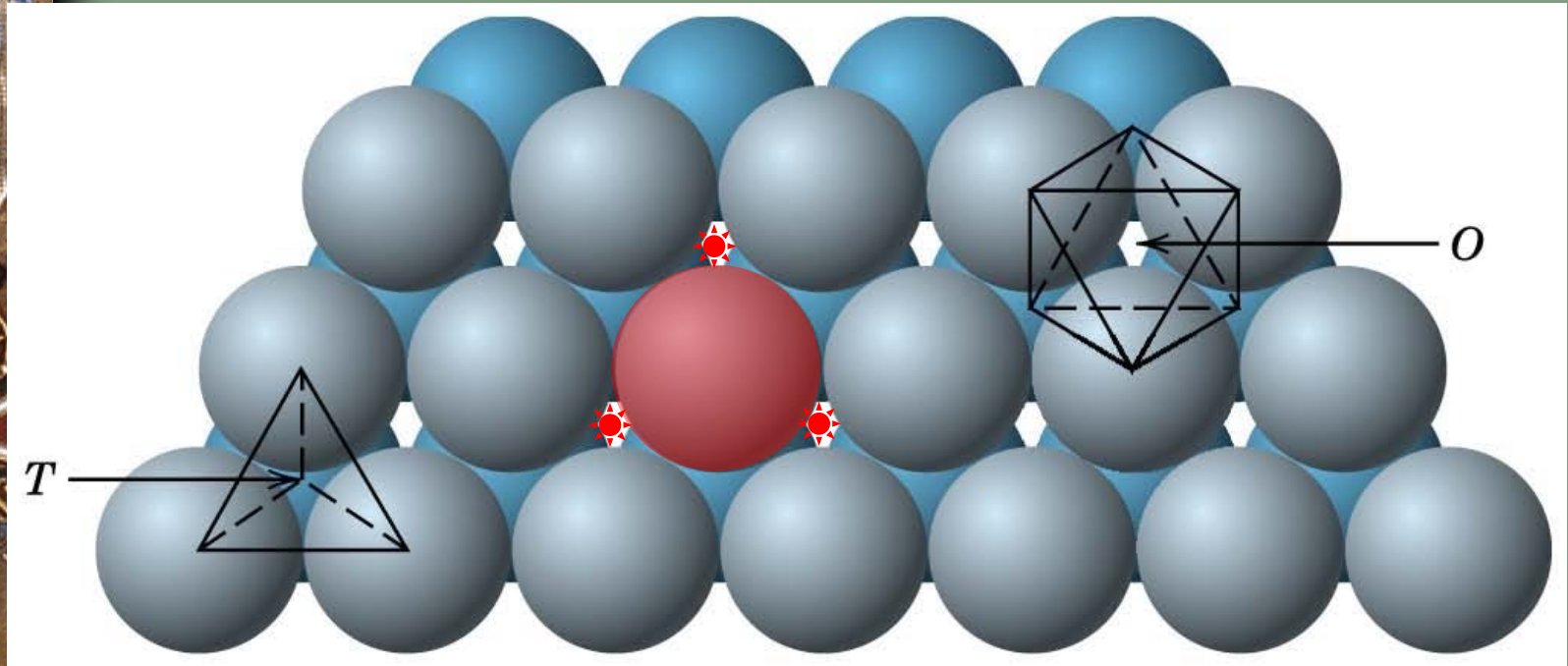
Crystal Structures from the Close Packing of Anions



- **Two tetrahedral sites per anion**
- $\rightarrow 1/4 \times 4 \times 2 = 2$



Crystal Structures from the Close Packing of Anions



- **One octahedral site per anion**
- $\rightarrow 1/6 \times 3 \times 2 = 1$



Crystal Structures from the Close Packing of Anions – Flash Animation

The screenshot shows a Microsoft Internet Explorer browser window displaying a Flash animation. The browser's address bar shows the URL `http://etz106.ust.hk/test/mech242/07_tetrahedral03.swf`. The page content includes the following text:

Department of Mechanical Engineering
Tetrahedral and Octahedral Atomic Position in Ceramic Material

..... Objective

In this animation, you can identify the available sites and locations for the cations residing in the close-packed 3-dimensional anion planes and explain how a single anion can provide one octahedral and two tetrahedral positions.

Click the 'Play' button to start

Copyright 2004 The Hong Kong University of Science and Technology

The interface features a navigation bar at the bottom with a 'Play' button (a right-pointing triangle) and a 'Previous' button (a left-pointing triangle). The browser's taskbar at the bottom shows the system tray with the time 14:01 and the language set to EN.



Remarks

- The goals of this work are
 - To enhance the students' participation
 - To enhance students' understandings
- Approach
 - To prepare this series of computer animations and experimental demonstrations available on the internet



Acknowledgements

- University Grants Committee
- *Wanze Li, Tak Ha, Charlotte Chow* of CELT in assisting the application of this project
- *Leo Lee* of Advanced Engineering Materials Facilities and *C.W. Kwok* of Department of Mechanical Engineering in supporting the experimental demonstration





Thank you

