Science and Technology of Fuel Cells: How we "see" things we can't see?

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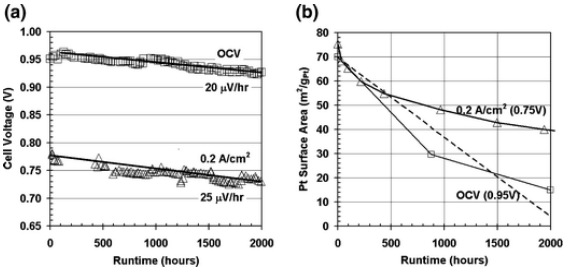
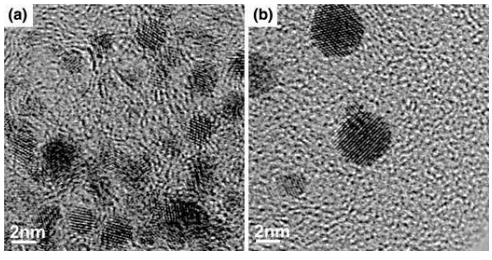
Fuel Cell Durability



Shao-Horn, Y.; Sheng, W. C.; Chen, S.; Ferreira, P. J.; Holby, E. F.; Morgan, D. Instability of Supported Platinum Nanoparticles in Low-Temperature Fuel Cells *Top. Catal.* **2007**, *46*, 285-305

Catalyst before and after operation



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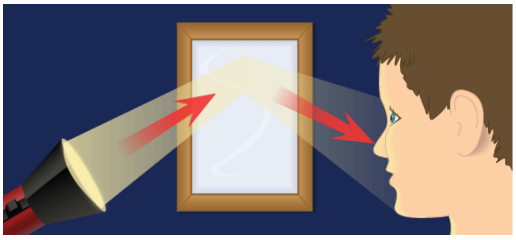
How small is nano?

- http://www.youtube.com/watch?v=bQzFpP4FSN4

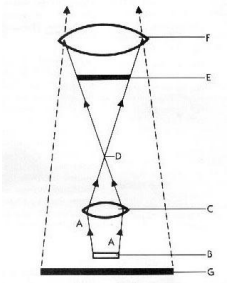
How we see things



http://bradfordschools.net/blog/hortongrange/2011/11/15/science-test-how-we-see-things/

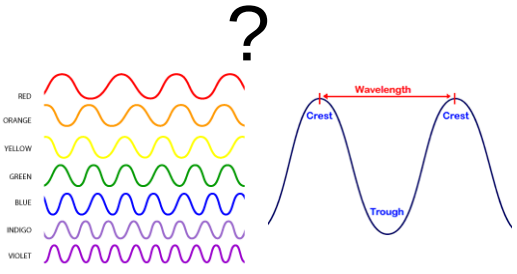
A classical (optical) microscope

The compound microscope uses two (or more) lenses to increase the size of the image focused on the viewer's retina. Light rays (A) travelling outward from an object (B) bend as they pass through the first lens (C). The rays converge at a focal point (D). The rays cross and spread out until they create an image known as the first image (E). The light rays making up this enlarged image are allowed to spread out further before they are bent inward by a second lens (F), the eye-lens. The rays passing through the eye-lens enter the eye at an angle, so they appear to be coming from a much larger object (G), the virtual or final image.

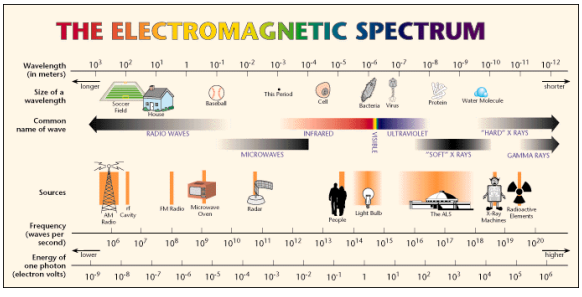


http://www.museevirtuel-virtualmuseum.ca/edu/ViewLoitDa.do;jsessionid=D96800BEAAE92FF081398478290015B1?method=preview&lang=EN&id=4076

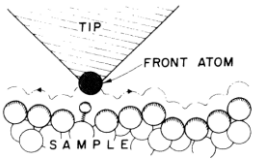
Can we see a cell membrane (10 nm) using an optical microscope ?



We need soft X-rays to see 10 nm. Hmm…



Atomic Force Microscopy



- Tip on cantilever is dragged along surface of the sample.
- Tip has attractive and repulsive interactions with surface of the sample.
- These cause the cantilever to be deflected.
- This deflection is detected and used to produce an image.

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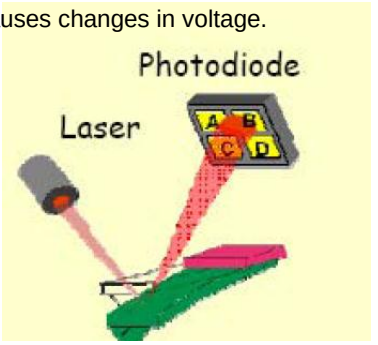
- Photodiode is used in detection.
- Changes to deflection of cantilever change position of reflected laser.
- This causes changes in voltage.



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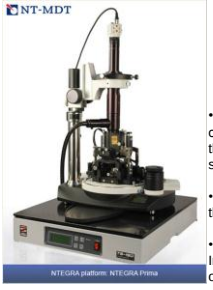
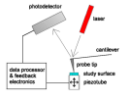
Scanning Probe Microscope (SPM)





• A Scanning Probe Microscope is an instrument that can be used to "see" the surface of a material through the interactions between a sharp probe and the sample.

•The things you "see" can be as small as one 1/1000 of the thickness of human hair. Nano science.

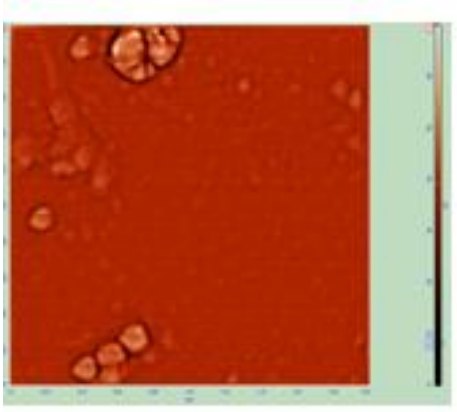
•You DO get an image, but it is NOT an optical image. In its simplest form, the image is a color representation of the sample topography.

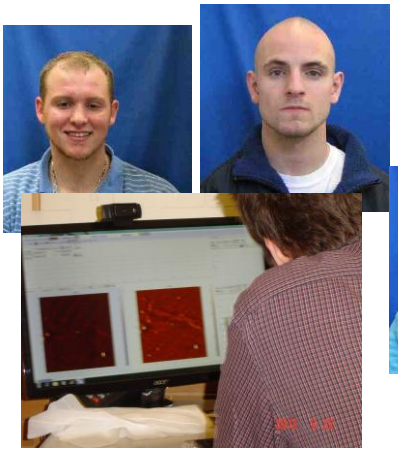
How does it work?

http://www.ntmdt.com/spm-principles/view/afm-constant-height-mode

http://www.ntmdt.com/spm-principles/view/afm-constant-force-mode

http://www.ntmdt.com/spm-principles/view/non-contact-mode





NSF-MRI: CHE-1039894

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