

**April-May, 2009**
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## Student's Question of the Day

### What is Transmission Electron Microscope?

The term microscopy deals with the use of microscopes in viewing objects and samples in biology, materials science and engineering disciplines. The three famous branches are optical microscope, transmission electron microscope and scanning probe microscope. Transmission Electron microscope is a solution to the limitations implicated due to light microscope which gives magnification of 500x - 1000x and a resolution of 0.2 micrometers only. As the scientific desire mounted to see more fine details of inner structure of organic cells and materials, it was in early 1930s that the first electron microscope was designed by Max Knoll and Ernst Ruska in Germany [1].

In order to understand how TEM works we may consider a slide projector which forms images by projecting light through a specimen. As the light passes through the specimen, it interacts with it

such that fewer parts of the specimen let it pass through completely while others allow partial transmission of light on the other side of it. This transmitted light hits the lenses placed on the other

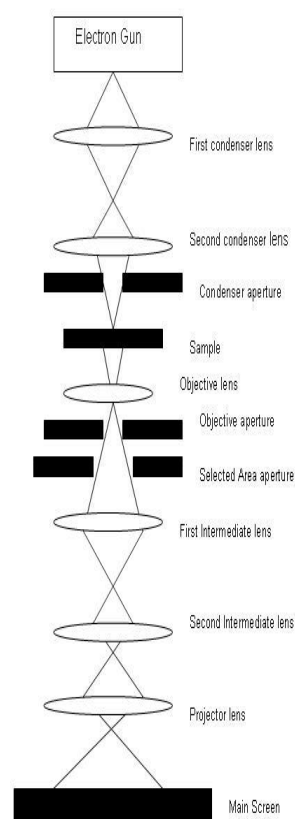


Fig. 1: Schematic setup of TEM

side of the sample which project the image on to a screen. In TEM this is done by an electron beam instead of light. As shown in Fig-1, an Electron Microscope consists of an electron gun and assembly of lenses in an evacuated metal cylinder of 2m length .These lenses are electromagnetic in nature placed at intervals down the column. Their focal length can be adjusted by regulating the amount of current through the coil of the lenses [2].

The basic steps involved in its working are as follows:

- Formation of beam through an electron gun
- Focusing of beam through electromagnetic lenses
- Interaction and transmission of the beam through the sample.
- Formation of image on a screen.

The electrons emitted by the tungsten filament are accelerated towards the anode plate due to high potential difference of 50-100KV .These electrons pass through a tiny hole in the anode to form an electron beam which passes down the column. The beam is made monochromatic and coherent using two condenser lenses .The first lens determines the range of the spot size which strikes the sample while the second condenser lens is used to change the its size from a wide dispersed spot to a fine sharp beam. Finally the beam is confined by the condenser aperture and made to fall on the sample and passed through it partially by interacting with the sample .This transmitted portion is focused by an objective lens to form an image .This image is passed through intermediate and objective lens

which impart further magnification to the image. This finally built image strikes the phosphor screen allowing the user to see it [3]. The transmission electron microscope makes us to see the objects of the order of few angstroms ( $10^{10}$ m) i.e. near atomic levels .TEM is used to gather following information: Morphology: The size shape and arrangements of the particles at atomic scales Crystallographic information: The arrangements of atoms and their degree of order ,detection of defects in areas of nanometers in diameters Compositional information : Identification of of the elements and compounds and their relative ratios in few nanometer range. Biological: To examination structural features of biological tissues, organism and cells [4]. There are a number of limitations of TEM technique such that, sample preparation is a time consuming process. The structure of sample may also be altered during the preparation. Moreover the beam covers very small portion of the sample while there is also a possibility of damaging of the sample by the electron beam, especially in the case of biological samples.



Fig.2: Philips CM-200, Transmission Electron Microscope  
(Image courtesy: Imaging Technology Group Beckman Institute of Advanced Science & Technology, University of Illinois)

## Few Images taken by TEM

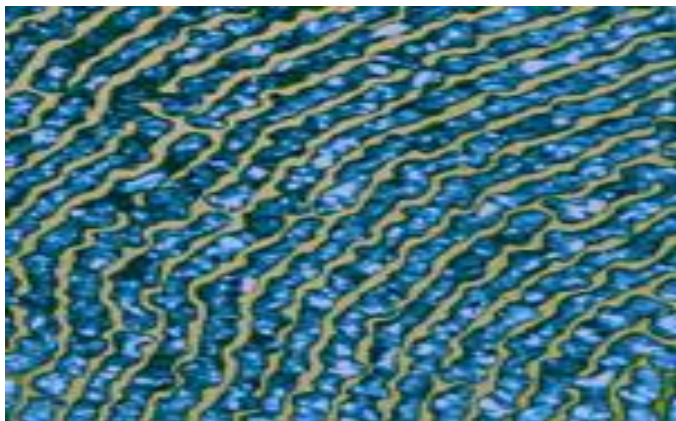


Fig.3: False-color transmission electron microscope image of self-assembled silver nanowires produced at the University of Chicago (**Image courtesy** of Heinrich Jaeger and Ward Lopes university of Chicago)

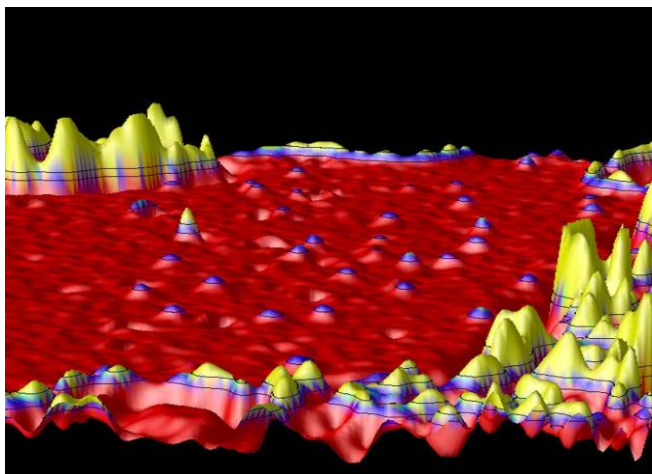


Fig.4: False color TEM image of an isolated hydrogen atom (Purple tips) and an isolated carbon atom (red tips) on a graphene membrane. The 'mountain ranges' in the background and foreground are of amorphous carbon. (**Image courtesy:** Zettl Research Group, Lawrence Berkeley National Laboratory and University of California at Berkeley.")

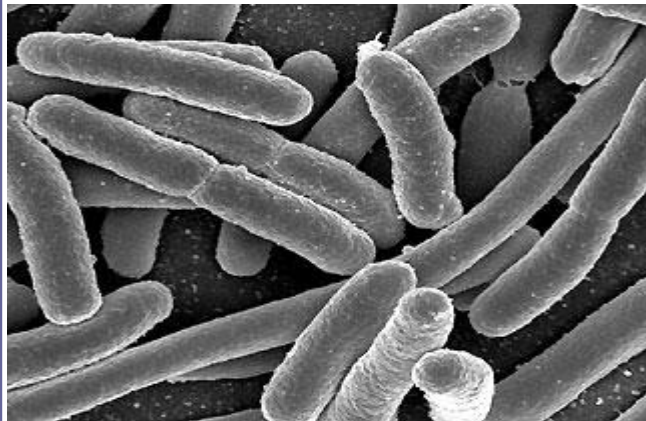


Fig.5: Coli bacteria under an electron microscope. (**Image courtesy:** [www.foxnews.com/story/0,2933,325369,00.html](http://www.foxnews.com/story/0,2933,325369,00.html))

## References:

1. [http://nobelprize.org/educational\\_games/physics/microscopes/tem/index.html](http://nobelprize.org/educational_games/physics/microscopes/tem/index.html)
2. Transmission Electron Microscopy - Basics by D.B.Williams and C.B.Carter (Plenum Press, New York, 1996)
3. *Electron Microscopy and Analysis* by Goodhew, Humphreys and Beanland (3rd Edition 2000).
4. <http://www.unl.edu/CMRAcfem/temoptic.html>

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## New Research

### A single molecule optical transistor

Since the appearance of the first laser, the scientists and engineers have been dreaming

to create photonic circuits in which electrons are replaced by photons. Now Vahid Sandoghdar and his colleagues at ETH Zurich have made a world's smallest optical transistor from a single dye molecule. The device works by amplifying a source laser beam which depends on the power of a second gating beam. The scientists hope that this discovery could bring all optical circuits and optical computing a step closer.

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### **Not wonder, this is Physics**

At sunrise the earth is moving towards the sun while at sunset it moves away from the sun. At both times it travels at an angle, such that it covers a longer distance in the atmospheres and encounters more obstacles in its path. Most of the colors like green and violet are scattered before the light reaches the earth. Since red color is scattered the least, this is the color which we see at sunrise and sunset.

### **News Bulletin**

1. It's a great pleasure to share this news that Director General, International Biographical Centre, Cambridge, England has announced Dr. Ashfaq Ahmad HOD Physics department as one of the top 100 Educators 2009.
2. A research paper by Dr. Muhammad Asif titled, "Large aspect ratio MHD equation for toroidal " has been published in " International Journal of modern Physics B", 23, (2009) 2463.
3. Dr. Andreas Kastner of LD-Systeme AG & Co. KG delivered a talk titled, "Importance of training equipment in educational institutes" on

April 1, 2009, at 12.30 P.M, in the seminar room of Block A.

4. Mr. Abdul Qayyum Kashmiri from University Silicon Integrated Solutions delivered a talk titled, "Essential Ingredients of ASCII Solution " on April 03, 2009 at 2.30 PM in the seminar room of Block A
5. Dr. Aqeel Ahsan Khurram Manager (Tech.), National Centre for Physics, Quaid -i- Azam University, Islamabad delivered a talk titled, "5MV tandem (pelletron) accelerator and its uses" on April 09, 2009 at 1.30 PM in the seminar room of Block A.
6. Dr. Samina Tazayyen, Assistant Professor, Education Department Government of Balochistan Quetta deliver a talk titled, "Chromotherapy and its Scientific Evolution" on June 12, 2009, at 12.10 P.M, in the seminar room of Block A
7. We are delighted to share great news that department of physics has won the final of basket ball of "the girl's sports gala May 2009" which was played between the department of physics and the electrical engineering. The team played enthusiastically under the captaincy of Inum Arshad scoring a total of six goals. The cricket team of department of physics and chemical engineering led by Muniba Shahid secured second position in the final cricket match of the same event. The final was played between physics and management sciences. We congratulate all the players for their commendable performance and wish them best of luck for future ventures.
8. An educational trip was arranged by the physics department on May 14<sup>th</sup>, 2009 to



Pakistan Radiation Services (PARAS). Dr. Ashfaq Ahmad (HOD) and the faculty also accompanied the students on the trip. Mr. Malik Ghazanfar Sadiq, General Manager PARAS, gave the briefing to students on the increasing demand of the Gamma sterilization for pharmaceuticals and food item. Overall, this was an extra ordinary event which opened new horizons for both students and faculty members.

9. World book day was celebrated at CIIT Lahore on April 29<sup>th</sup>, 2009. A walk was organized from Library to Mosque in which large number of students and teachers were present. Whole campus was decorated with colorful charts and banners reflecting the importance of the book reading. The main aim of the walk was to create awareness among the students about book reading. The students and faculty of the physics department actively participated in the event.

## Photo Gallery

Some of glimpses of the Seminars held in the Physics Department are posted below.



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- Arrangement of Seminars / workshops
- Arrangement of educational trips
- Organization of Co-Curricular activities e.g. Quiz competition, Research and general paper reading contest etc

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