MINISTRY OF HIGHER EDUCATION AND SIENTIFIC RESEARCH - SAWA UNIVERSITY - ENGINEERING COLLEGE -PHYSICS DEPT. SECOND STAGE 2.nd COURSE

جامعة ساوة الاهلية

كلية التقنيات الهندسية

القسم: الفيزياء الطبية والعلاج الاشعاعي

المرحلة الثانية /الفصل الثاني

عنوان المحا ضرة:

The Atom

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رقم المحا ضرة (1)

The Atom

presentation title

LECTURE NO. (1)

The Atom

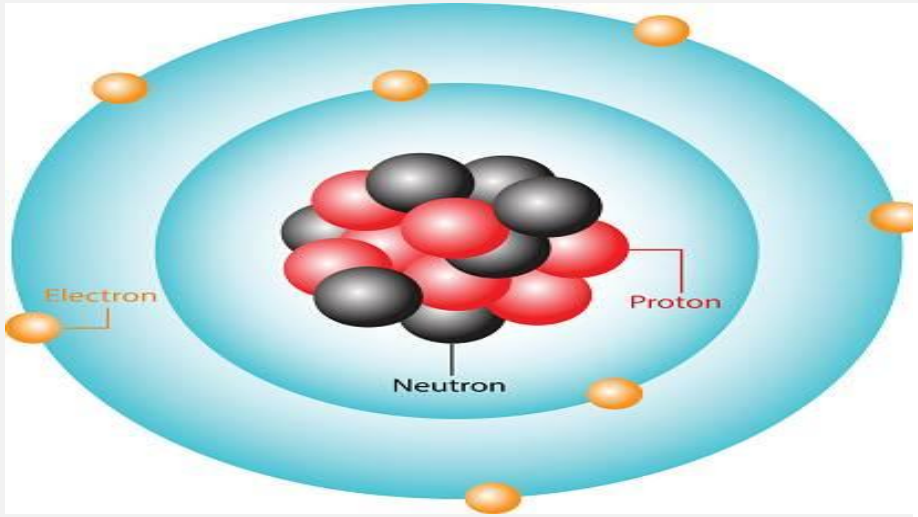
The atom is a smallest part of the matter which has the same properties of th element.

Atomic models are an important part of physics instruction at many different level Students learn simple models of atoms in elementary school and gradually integrate mor complex ideas into these simple models throughout their education.

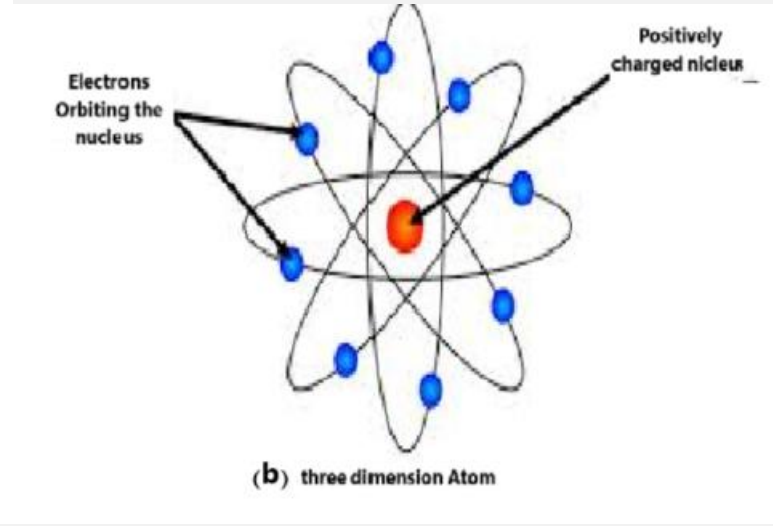
Bohr's atomic model

Typically ,The model of the atom was proposed by Neil Bohr in 1915. It came into existence with the modification of Rutherford's model of an atom. Rutherford's model introduced the nuclear model of an atom, in which he explained that a nucleus (positively charged) is surrounded by negatively charged electrons.

Bohr's atomic model



(a) Bohr's model



Fig, (1) Bohr's Atomic Model

Theory of Bohr modified the atomic structure model by explaining that electrons move in fixed orbitals and not anywhere in between and he also explained that each orbit has a fixed energy. Rutherford explained the nucleus of an atom and Bohr modified that model into electrons and their energy levels.as shown in figure (2) below:

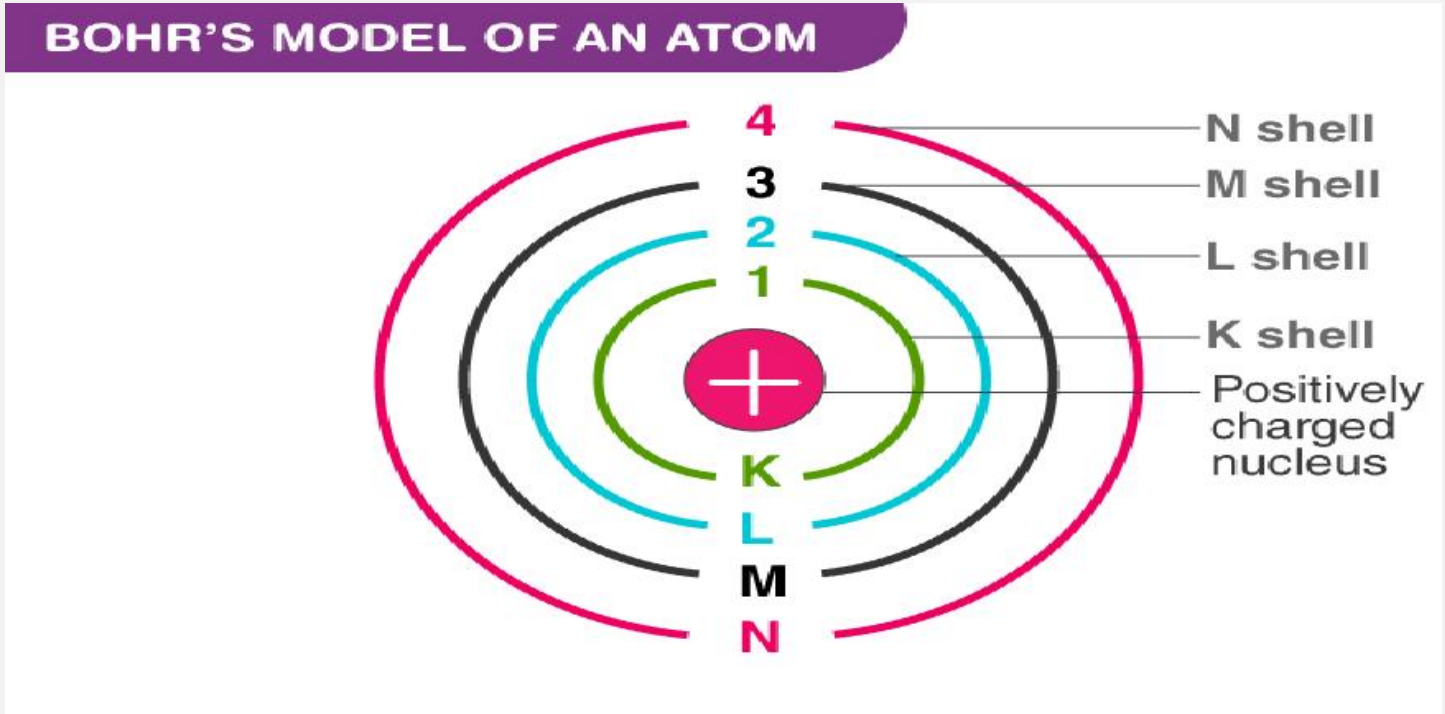


Fig (2) Bohr's Model of an Atom

Elctron's enery levels

Typically , in the atom , electons circle the nucleus in the same way that planets orbit the sun .Negative electrons are attracted to the positive nucleus .Consequently , it takes energy to move an elecron away from the nucleus to outer circle(orbit)

The circles where electrons orbit are referred to as energy levels or shells.Electrons in the outermost circles have higher energy since it requires more efort to pull the electron a greater distance from the nucleus .

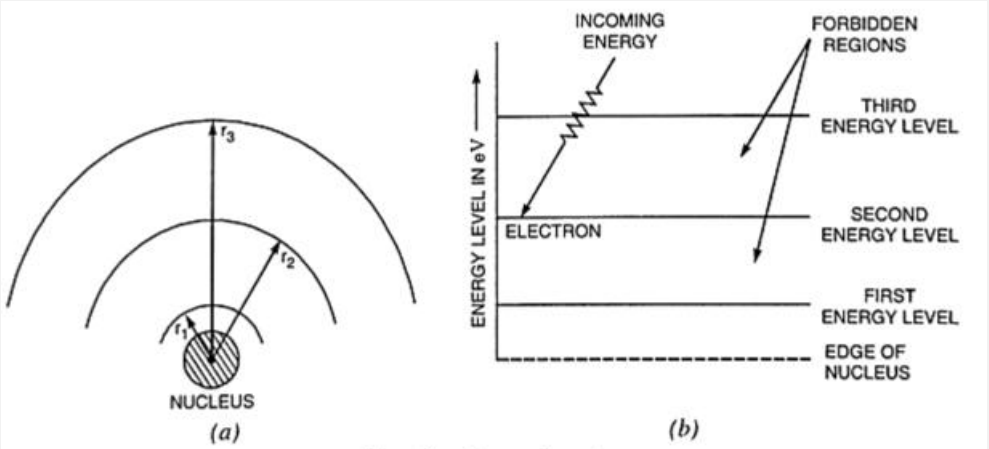


Fig. (3) *Energy Level*

The energy levels are numbered 1,2,3, etc.Energy levels are called principle quantum numbers . Normally, the letter "n" is used to represent the energy level.The smaller the number the closer the energy is to the nucleus.The energy level that is closest to the nucleus has a value of n=1

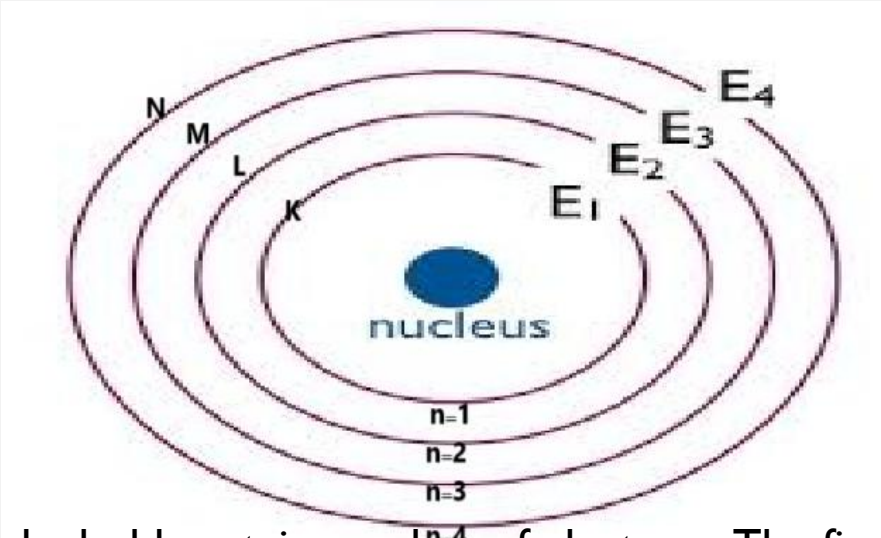


Fig. (4) energy levels

Each energy level can only hold certain number of electrons.The first energy level can only hold (2) electrons , the second can only hold (8) electrons and the third level can hold 18 electrons ,while the fourth level can only hold 32 electrons and so on ....

Hence we can use the following to predict the number of electrons that can fit into a shell.

Math. Formula : the maximum number of electrons = $2n^2$

Within each energy level are sublevels . wich are labeled s,p,d, and f .We can memorize these (4) sublevels as in following table :

n	sublevels inside
l	s
2	s,p
3	s,p,d
4	s,p,d,f

Each sublevel has a spesific numer of orbitals as in following table :

sublevel	the number of orbitals in the sublevels
s	l
p	3
d	5
f	7

A maximum of 2 electrons can occupy an one orbital .

Energy levels Daigram of Oxygen atom as in Fig.(5) :

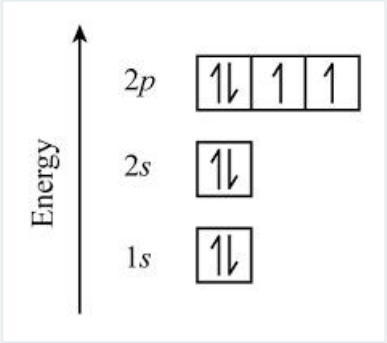


Fig.(5) Oxygen Atom

Energy Bands

According to the band gap (between the valence and conduction bands), materials are classified into three types: (i) metals (conductors), with a band gap value = 0 eV; (ii) insulators, with a band gap value in the range between >3.0 eV; and (iii) semiconductors, with a band gap value 0.1-3.0 eV [. So ,there are three types of energy bands:

(a) Conduction Band

It is a delocalized band of energy levels in acrystalline solid which is partly filled with electrons. it also, has higher energy.it associated with free electrons.

(b) Valence Band

It is the band of energy where all of the valence electrons reside and are involved in the highest energy molecular orbit. It is tightly bonded to the orginal aton.

the above two bands are the permissible bands

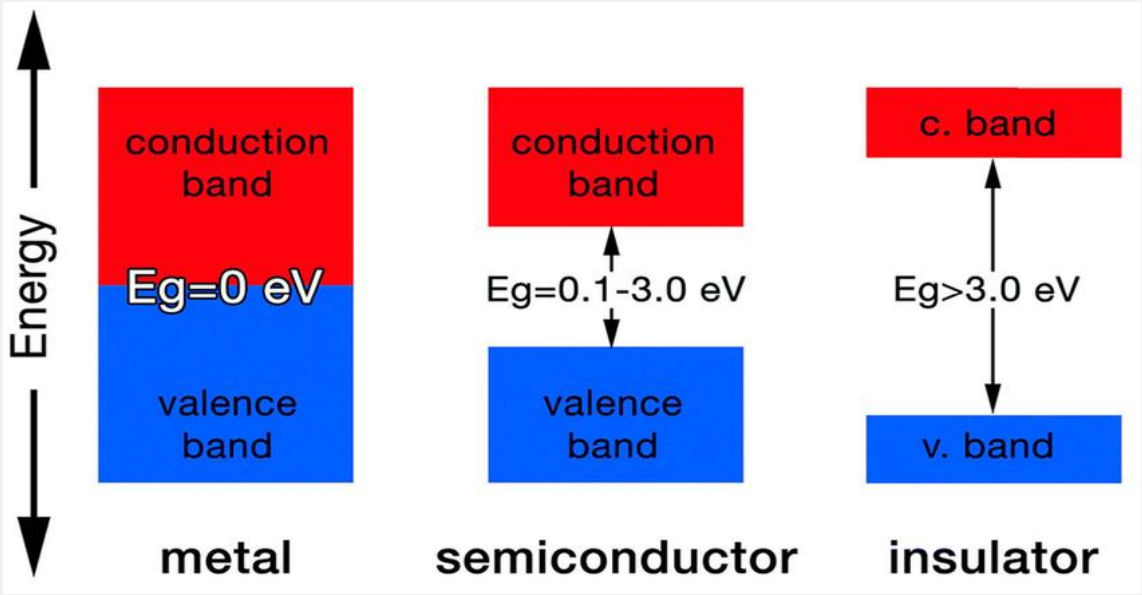


Figure (6) Energy bands and energy Gap

(c) Forbidden Band (Band Gap):

Gap between the valence band and the conduction band is called a forbidden energy gap . usually. it is greater than 3 eV and it greater than an other energy bands

Semiconductors

A semiconductor is a material that lets electrons flow through it under certain conditions.An intrinsic semiconductor, also called a pure semiconductor, undoped semiconductor or i-type semiconductor, is a semiconductor without any significant dopant species present. The number of charge carriers is therefore determined by the properties of the material itself instead of the amount of impurities. In intrinsic semiconductors the number of excited electrons and the number of holes are equal: $n = p$.

While ,if some significant dopant species present ,The number of charge carriers is determined by amount of impurities as well as the properties of materials. with addition of impurities we will optain N- type semiconductor and P- type semiconductor, which will mention later.

Crystalline Semiconductor

When atoms combine to form a solid, they organize themselves into an orderly pattern called a crystal. The forces that hold atoms together are called covalent forces.

silicon crystal lattice

Home Work
Germanium Atom
Draw the Lattice
Atomic Number(32)

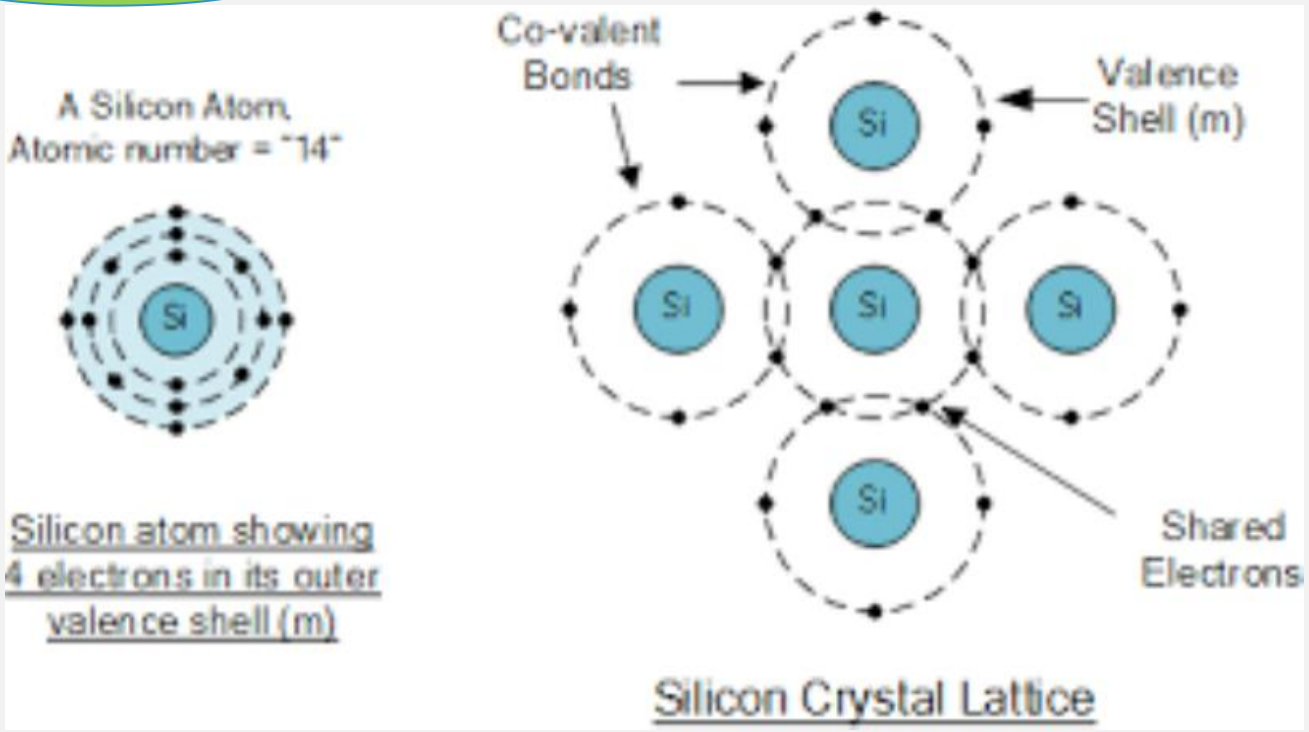


Figure (7) Pure Silicon Crystal Lattice

The pure silicon crystal ,when all it's atoms are only silicon ,usually called intrinsic semiconductor , and the current carriers are pairs of "Electron -Hole" typically , in in practical applications ,There are not enough numbers to produce useful currents.

In order to increase current carriers ,we have to add the specific impurities . there are two types of additive impurities “” pentavalence and trivalence “”. When we add pentavalence atons ,we obtain N-type semiconductors, while ,the addition of trivalence atoms will give us P-types semiconductors

عادة ، تم اقتراح نموذج الذرة من قبل نيل بور في عام .1915 ظهرت إلى حيز الوجود مع تعديل نموذج رذرفورد للذرة .قدم نموذج رذرفورد النموذج النووي للذرة ، حيث أوضح أن النواة) موجبة الشحنة (محاطة بإلكترونات سالبة الشحنة.

النواة حول الإلكترونات تدور الذرة، في عادة، حول الكواكب بها تدور التي الطريقة بنفس الشمس

Inorganic semiconductors like silicon and germanium are the foundation of modern electronic devices. However, they have certain limitations, such as high production costs, limited flexibility, and heavy weight. Additionally, the depletion of natural resources required for inorganic semiconductor production raises concerns about sustainability. The

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في الطاقة مستويات من متمركز غير نطاق عن عبارة وهو
بالإلكترونات جزئيًا مملوءة بلورية صلبة مادة

انتهى .... شكرا لاستماعكم