NAME : G. Ra...

SUB : Physics

REG NO: 111719104129

A. Leonard

11)
b) i) Domain Theory Ferromagnetism.

we can observe that ferromagnetism such iron do not have magnetization unless they have previously placed in external magnetic field but according to weiss theory the molecular magnets the ferromagnetic material said to aligned in such that they exhibit magnetization even in absence external magnetic field ~~to~~ these is called spontaneous magnetization.

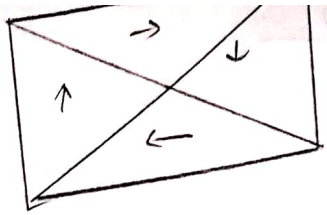
According to wiess hypothesis single crystal ferromagnetic magnetic material divided large number of small regions called domains.

The boundaries seperating domains called domain walls. These domain analogous to the grain boundaries polycrystalline materials.

Domain magnetization

In absence of field

* magnetic dipoles are aligned in parallel manner inside the domain the called spontaneous
* The Direction spontaneous magnetization varies domain to domain therefore net magnetization is zero

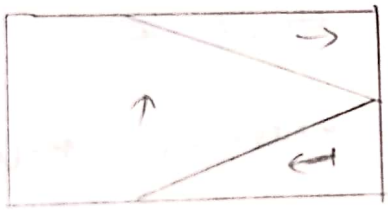


(ii) In the presence of the field

when the external field the applied the following two possible alignments occures.

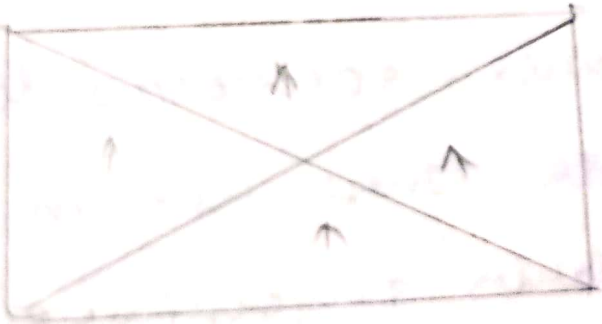
(a) motion Domains walls.

when the applied weak volume of the domain which the direction the external field get increased others shown below



b) Rotation of domains

when the external field strong. direction all the magentic dipoles domains gets shifted along direction external field.



NAME : G. RAMBALAJI

11

(b) Energies involved in Domain Growth.

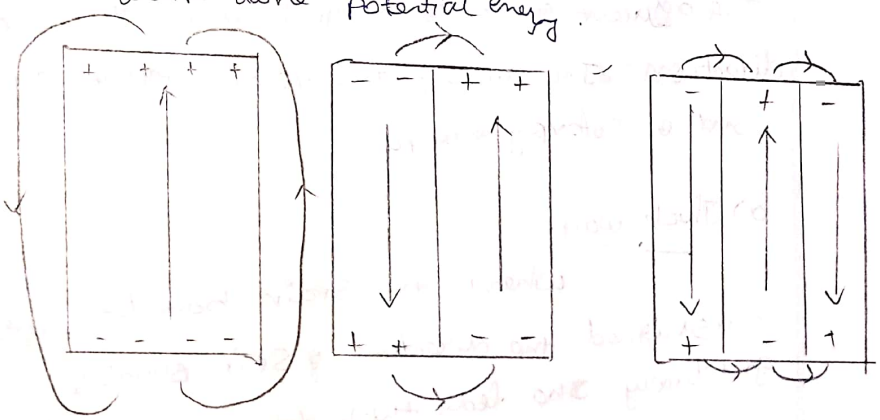
The study the domain clearly we must known four types energy involed process domain growth.

* Energy energy
* Anisotropy energy
* Domain wall energy
* magneto - stricitive energy.

* Exchange energy

The interaction energy which adjacent dipols algin themselves is known exchange energy (or) magnetic feild energy. The exchange energy estabished a sigle domain in specimen of ferromagnetic It is energy assembling atomic magnets sigle domain

work done potential energy.



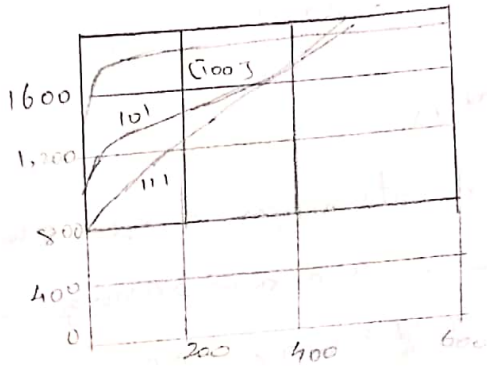
* Anisotropy energy.

In ferromagnetic crystal there are two direction of magnetization * easy direction
* Hard direction.

The easy direction magnetization weak field can applied hard direction of magnetization strong field should applied. for producing the same

saturation magnetization along both hard and easy easy direction fields required hard direction than easy direction

In Iron easy direction [100] medium direction [110] and the hard direction [111] and from the very strong field Procedure magnetic saturation hard direction [111] compared easy direction [100]



Domain wall energy :

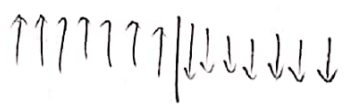
Domain wall is transition which separates the adjacent domains magnetized two different direction. The energy due to both exchange energy and anisotropy energy.

a) Thick wall

when the Spain boundary the misaligned the direction of spin changes gradually the leds thick domains wall. Here misalignments of Spins are associated exchange energy

Thin wall

when the spin the boundaries changes abruptly then anisotropy energy becomes very less since anisotropy energy directly proportional to Thickness the wall this leads thin Bloch wall



* magetostrictive energy

when the domains are magnetized direction they will either expands (or) shrink. Therefore exits deformation change dimension of material when magnetized this phenomenon is know magnetostriction and energy produced the effect know magnetostriction and energy produced in this effect is known magnetostriction energy.

12)

A)

i) (GMR)

Giant magnetoresistance (GMR) quantum mechanical magnetoresistance effect observed in multilayer composed ferromagnetic layers alternating ferromagnetic and non-magnetic conductive layers.

The effect is observed is significant change the electrical Resistance depending on whether the magnetization of adjacent ferromagnetic layers parallel or on antiparallel alignments

The main application of GMR sensor which are used data is hard disk drives biosensors micro electromechanical system (MEMS) other devices. GMR multilayer structures are also used magnetoresistive random-access memory (MRAM) store information.

Introduction

HDD hard disc drives those up magnetic garnets material are called magnetic hard disk drive. It is more data storage device, ~~not~~ so costly for storing to a very high level in terms of ~~peta~~ ~~EE~~ Tera bytes. (GMR) high magnetic sensitivity data at greater speed

Principle.

In hard disc drive binary data in terms 0's and 1's are stored by inducing magnetic moments in thin magnetic layer and (GMR) effect used principle to read data HDD

Construction

The HDD consist recording medium made up of thin layer magnetic garnets grown over the substrate. GMR sensor, which made up of ferrites and antiferromagnetic material is used a reading element.

The writing element and GMR sensor shall be made to slide over the recording media in the longitudinal direction shown in figure method also called longitudinal recording.

The flow the current through GMR sensor and writing element shall be adjusted on turn the magnetization sensed or controlled the recording media.

working

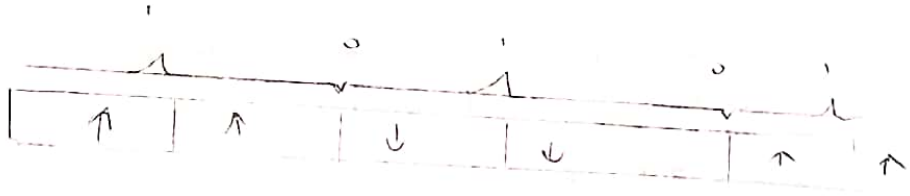
* Initially the current is passed through writting element field included between the gap of inductive magnetic transducer.
* During writing the amplitude of the current kept constant and the direction current reversed
* When induced magnetic field greather than coercivity the recording media the data recorded form of 1
* Thus one (1's) stored data recording medium as magnetic transition.

Reading / retreiving:

1) Giant magnetic Resistive (GMR) effect is the principle used to read / retrieve data from recording medium.

2) When the GMR sensor is made to move near the recording medium, then Resistance of the GMR sensor varies with orientation magnetic moments. follows.

3) When the layers magnetized in parallel manner resistance in GMR sensor is minimum therefore current flows through the sensor which represents data.



(12) b)

Advantages

* It has very large storage capacity
* GMR sensors non-diffusive and are very sensitive reading
* The size of the recording medium in HDD shall reduced up to few nano meters using nano Technology.
* HDD can store the data in terms of Tera bytes and further can store data terms peta bytes Exa bytes.

Disadvantages

* HDD slower than solid state device
* They consume more power and will damage dropped even at a smaller distance
* HDD has Bulkier factor
* The GMR noise high for the nano size recording media as Temperature dependent

(13) Photo current Diode.

A Photodiode essentially a reverse biased p-n junction diode which designed to respond to photon absorption

Principle:

A reverse biased p-n junction diode has a reverse saturation current which is mainly due the flow minority carrier. when the light incident on depletion region of the reverse based on pn junction. the concentration minority carries (electros pn junction holes n-side) increase to a great extent - But change minority carriers too low consequently reverse current increases. The reverse current through diode varies almost linely with intensity of light.

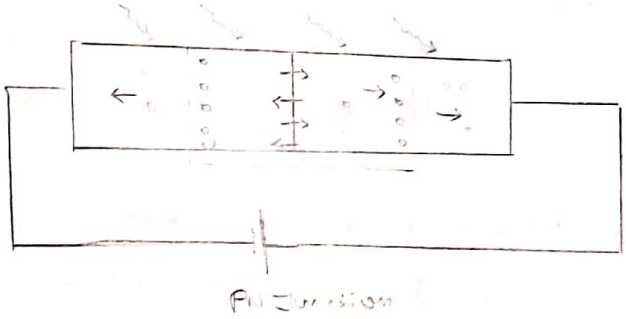
Construction:

A photo diode consists P-N junction embedded clear plastic capsule. The symbol of the photo diode.

Light is allowed fall upon one surface across the junction All the plastic capsule except illuminated one either painted black or enclosed metalic.

Working

* The photo diode kept under dark Condition and suffient reverse voltage applied then almost a constant current an inverse magnetic reverse bais obtained.

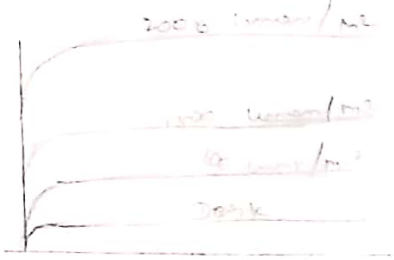


PN Junction

If called dark the proportional consentrations of carriers and is by Id.

* when light falls diode surface or additional electron hole pairs formed. but since concentration of majority carriers is much greater as compared to the minority carriers the Resistance increases of majority carrier is smaller than Resistance increases minority carriers

$I = I_s + I_d$



The photocurrent increases with increase intensity light falling on the p-n junction

SOLAR CELL

Solar cell is also called photovoltaic cell. It is electrical device that converts energy light directly into electricity photovoltaic effect.

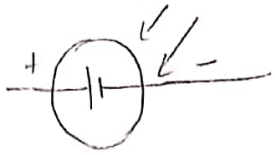
Principle:

A solar cell is basically solar cell nothing but light emitting operating in reverse

Common material for solar cell include Silicon gallium Arsenide Indium Arsenide and cadmium telluride the most common Silicon. for silicon bandgap 1.12eV the max theoretical efficiency solar cell depends on the band gap.

Construction:

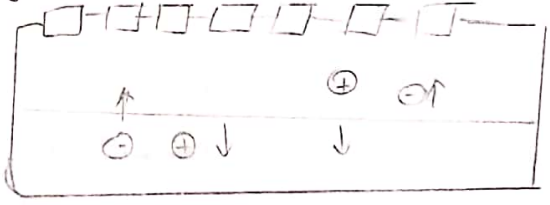
A Solar cell consists of PN junction diode made si schematic symbol solar cell.



PN Diode consists glass window on top light may fall P and N material. the thickness P-region kept very small so electrons generated region can diffuse junction recombination place.

Working

* When light radiation P-N junction diode photons valence electrons and impact sufficient energy enabling them leave their parent atoms. The electrons and holes reach depletion diffusion region diffusions.



* However the minority carriers electrons in the p-side slide down the barrier potential to reach N-side holes N-side move P-side as flow constitutes minority current which Directly Proportional to illumination also dependent area being light.

* The open-circuit voltage Produced for a silicon solar cell typically 0.6V at short-Circuit

Advantage:

* Solar cell operates fair efficiency
* It unlimited life time
* It high power capacity per weight
* It small and compact

Disadvantage:

* Instalation / Investment cost in high.
* It seasonal energy can't work under winter / rain seasons.
* The solar panels occupy more space installation

(14)

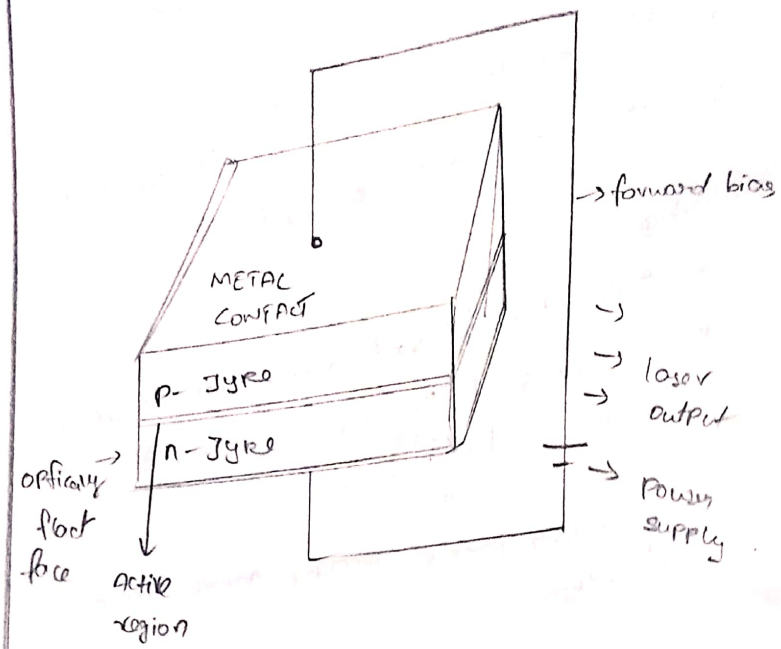
LASER DIODE

* Homojunction diode Laser.

It specify fabricated p-n junction device which emit coherent light under forward biased condition

Principle:

The electron in conduction band combines with a hole in the valence band and produces a light photon. This photon induces another electron from conduction band to move to the valence band and stimulate the emission of another photon.



A P-N junction made from crystalline (GaAs) is active medium the ends of pn junction diode well polished and parallel each other. It is optical resonator. when junction is forward biased excess minority electrons regions minority holes forms P regions accumulate on either side PN-junction and hence active region develop stacked photon $E = h\nu$ released.

The emitted photons increased the rate of recombination including more recombination

$\lambda = hc/E_g$

Advantage

* It exhibits high efficiency
* It requires very little auxillary equipments.
* It can have continuous wave output

Disadvantage

* The poor coherence poor stability
* Threshold current density very large
* It is difficult control mode pattern mode structure large.

Application

* The widely used fiber optic communication.
* It also used pain killer
* It is used heal wounds by infrared rad

Heterojunction

Heterojunction means the material or one side the junction differs from that on the otherside the junction

Principle:

the electrons in conduction band combines with hole the valence band and produces a light photon

construction and working

In GaAs in diode laser layer GaAs sandwiched between two layer GaAlAs which have wider energy gap and lower refractive index GaAs. The active region GaAs where the laser emission takes places. The band gap difference from potential barriers which prevent electrons takes place. Thus active region very narrow. the step change refractive index provides efficient wave guide structure. The strike geometry provides stability longer life time for diode. when Diode suitably forward biased holes 2nd layer injected & injected 3rd layer thereby creating active region spontaneous combination in the active region trigger laser action homojunction laser

Advantage:

* very narrow beam with high coherence and monochromaticity is achieved.
* continous operation possible
* carrier and optical confinement can be achieved simultaneously.
* These highly stable longer life.

Dis Advantage:

* cost higher than homo junction laser.
* practical difficults growing different layers p-n junction.

(15)

LED

Light emitting Diode (LED) is optical semiconductor p-n junction converts electrical energy under forward biasing.

Types of LED:

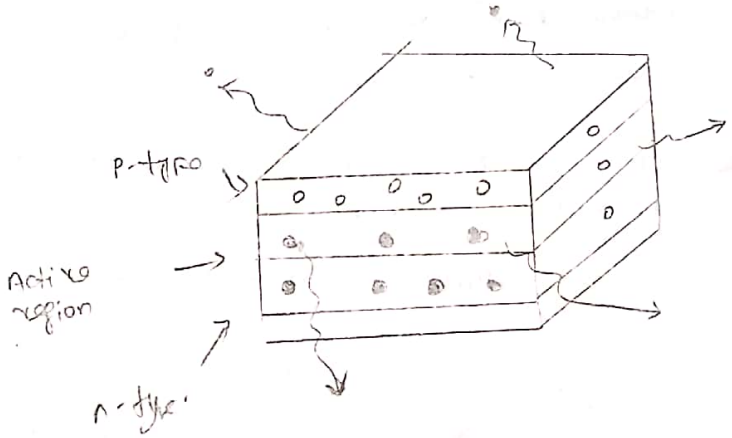
i) Planner &
ii) Dome shaped LED

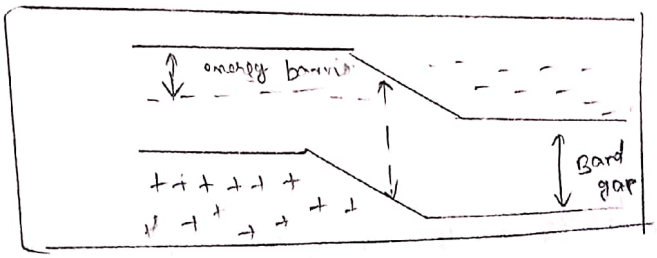
Principle

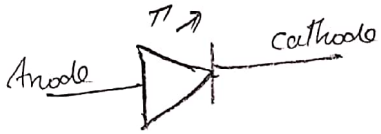
When light Emitting Diode (LED) is forward biased free electrons the conduction band recombines with holes valence band and releases energy from the light.

Construction:

A light emitting diode (LED) consists three layers p-type semiconductor, n-type semiconductor. depletion layer.







working

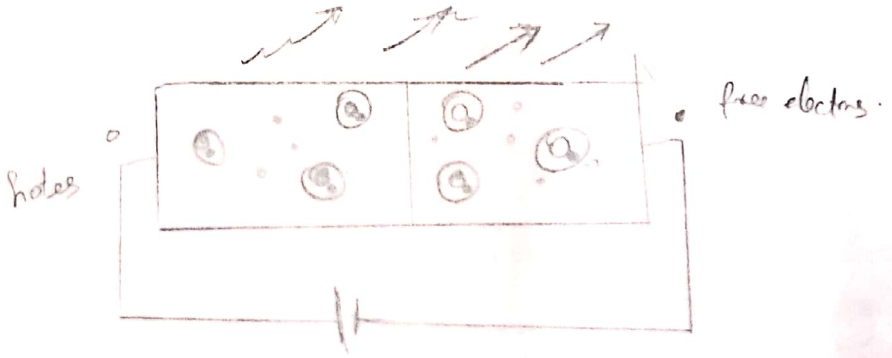
* Light Emitting Diode (LED) works only forward bias condition when light Emitting Diode (LED) forward biased. free electrons n-side and holes P-side pushed the junction.

* Because the recombination free electrons the holes depletion region the width region decreases.

* Thus recombination take place depletion region as well p-type and n-type semiconductor.

* They silicon and germanium diodes, most of energy from released from of heat and emitted to small.

* However in material like gallium arsenide and gallium phosphate emitted photons. Sufficient produce intensee visible light.



Advantage

* Light emitting diode low energy
* LEDs very cheap and readily available
* LEDs have longer lifetime
* LED can emit different colours light.

DisAdvantage

* LEDs and more power operate than normal p-n junction diodes.
* Luminous effeciency LED is low.
* Intensity is less than laser.
* The light not have directionaly.

(OLED)

An organic light emitting diode light emitting diode which the photo emissive electro luminescent layer is a film organic compound. they layer organic semiconductor situated between two electrodes ; it emits response light electric current.

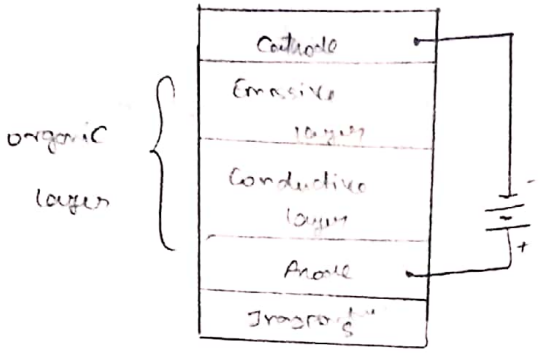
Principle:

An electron moves from cathode to the emission layer and hole move from the anode to the conductive they produce photons. this is principle used to emit light OLED.

Fabrication:

2-layer OLED consists of cathode and an anode between which we have organic layers viz.

* Emissive layer.
* Conductive layer.



Working

* voltage is applied across the OLED
* Due to applied voltage cathode give ebotrons. to the emissive and Conductive layer.
* In other words we can say anode gives ebotron hole.
* Now due to the ebotrostatic forces between these ebotrons holes they closes to combine each other
* In OLED the recombination occures closer emissen layer, because organic semiconductor move faster ebotrons.

Advantages

* OLED very thin and more flexable
* They are light weight
* Light emission brighter than normal LEDs
* The conductivio emissive increased the effect.

Disadvantage:

* Cost very high.
* It can easily damaged when water falls.
* Blue OLED flexible display boards, for display ridio real time.

PART - A

④ Curie Temperature

Curie Temperature critical temperature below which material can behave ferromagnetic material and above which behave paramagnetic material

⑭ magnetic

magnetic domains are small region in ferromagnetic material which has a group of atoms. The material can be magnetised under ferromagnetic exchange spin-spin interaction

⑤ Principle of HDD

In HDD the data specified as 0's and is are stored by induced magnetic moment in the magnetic layer and time effect is used as principle the read data.

⑥ Radiative Transition

* when electrons in condition band combined with the holes in valence band and the band and the energy is radiative in the form light

* Photon are emitted

Non-Radiative Transition.

When electrons in Conduction band collide with lattice points energy is radiative in the form of heat

phones are emitted,

(7) various types of colour centres

* R_1 - center
* R_2 - center
* m - center
* V - center
* F - center
* F : center
* V_2 : center
* V_1 : center

(8) Given:

$E_g = 0.02\ eV$

$\lambda_{long} = ?$

$E_g = h\lambda = hc/\lambda$

$$hc/E_g = \frac{6.625 \times 10^{-34} \times 3 \times 10^{8}}{0.02 \times 1.6 \times 10^{-19}} = 621.09 \times 10^{-7}$$

(9)

If the element of wavelength 4000A° - 7200A° is used make LED's the energy gap would 732 to 3.101 eV Therfore the element belong the group III and IV have bond gap 1.7 to 3.1 So they are used manfacture of LED

(10) Optical data storage:

In Optical dat storage a layer beam is used to read and write data creating dark pits.