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Pro : Bs Radiology

Q2 Explain the latent image formation?

Ans Latent image formation :-

The image forming x-ray exiting the patient and incident on the radiographic intensifying screen film deposit visible light energy in the emulsion primarily through photoeclectric intereaction with atom of the silver halide crystal. This energy is deposited in a patten that is representative of the object or anatomical part that is being radiographed. Immediately after exposure no image can be observed on the film. An invisible image can be observed on the film. An invisible image is present, however, and is called a latent image. With proper chemical processing the latent image becones a visible image. The interaction between photons and silver halide crystals is fairly well understood as is the processing of the latent image into the visible image. However, the formation of the latent image, some time called the photogaphic effect, is not well understood and continues to be the subject of considerable research. The following discussion is an extraction of the Gurney-Mott theory the accepted although incomplete explanation of latent image formation.

Silver Halide crystal: The silver bromine and iodine atoms are fixed in the crystal lattice in ion form. Silver is a positive ion, and bromide and iodide are negative ions. When a silver halide crystal is formed, each silver atom releases an outer-shell electron, which becomes attached to a halide atom (either bromine or iodine). The silver atom is missing an electron and therefore is a positively charged ions identified as Ag^+. The bromine and iodine atoms each have one extra electron and therefore are nagatively charged ions, identified as bromide and iodide (Br^- and I^-) respectively.
The silver halid crystal is not as rigid as some crystals such as diamonds. Under certain condition, atoms and electrons are free to migrate within the silver halid crystal.
The halid ions, bromide and iodide are generally found in greatest concentration along the surface of the crystal. Therefore the crystal takes on a negative surface charge, which is matched by the positive charge of the interstitial silver ions the silver ions inside the crystal. An inherent defect in the structure of silver halide crystals.

The frankel defect, consists of interstitial silver ions and silver ion vacanies. Presents a model of the silver halide crystal.

Photon Interation with Silver halide Crystal

When radiation interacts with film, it is the interation with the silver and halide atoms (Ag, Br, I) that forms the latent image. If the x-ray is tollay absorbed, its interation is photoelectric. If it is partially absorbed, its interation is compton. In both cases a secondary electron either a photoelectron or a compton electron - is released with sufficient energy to traval a large distance within the crystal ondary electron may have sufficient energy to dislodge additional electrons from the crystal lattice. Secondary electrons liberated by the event migrate to the sensitivity center and are trapped. Once a sensitivity center captures a photoelectoron and becomes more negatively charged, the center is attractive to mobile interstital silver ions. The interstitial silver ion combines with the electron trapped at the sensitivity center to form metallic silver atoms. Most electron from the bromide and iodide ions b/c these negative ions have one extra electron, these negative ions therefore are converted to neutral atoms, and loss of ionic charge results in disruption of the crystal lattice.

Latent image :-

The concentration of electron at the sensitivity center produce a region of negative electrificat-ion atoms are removed from the crystal the positive silver ions are electrostatically attracted to the sensitivity center. After migrating to the sensitivity center the silver ions are neutralized by electron and are converted to metallic silver.
This group of silver atoms is called a latent image.
crystal with silver deposited at the sensitivity center are developed into black grains crystal that have not been irradiated remain crystalline and inactive. processing is the term applied to the chemical reactions that tranfrom the latent image into a visible image.

Q3, Briefly describe the construction of radiographic film with diagm?

Ans 3 FILM CONSTRUCTION:-

The manufacture of radiographic film is a precise procedure that requires tight quality control. Manufacturing facilities are extremely clean become the slightest bit of dirt or other contaminant in the filum limits the film's a ability to reproduce information from the x-ray beam.

During the early 1960s at the the height of nuclear weapons testings x-ray film manufacture took extraordinary precaution to ensure that contamination from radioactive fallout did not invade their manufacturing environment Such contamination could seriouly fog the film

Radiographic film has two parts: the base and the emulsion In most x-ray film the emulsion is coated on bothe sides; therefore it is called double emulsion film. B/w the emulsion the base is at thin coating of material is called the adhesive layer which ensure uniform adhesive of the emulsion to the base. This adhesive layer allows the emulsion and base to maintain proper contant and integrity during use and processing. The emulsion is enclosed by a protective covering of gelatin called the overcoat. This overcoat protecte the emulsion from scratch, pressure and contamination during handly processing and storge and allows for relatively rough manipulation of x-ray film before exposure. processed film may be handled with even less regard for damage. The thickness of radiographic film approximately 150 to 300 μm.

Base :-

The base is the foundation of Radiographic film. It's primary purpose is to provide a rigid structure onto which the emulsion can be coated. The base is flexible and fracture resistant to allow easy handling but is rigid enough to be snapped into a viewbox.

③

conventionl photographic film has a much thinner base then radiographic film and therefore is not as rigid can you imagine attempting to snap 14 x 17 - inch photogrphic negative into viewbox the base of radiographic film maint-ains its size and shape during use and processing so that it dose not contribute to image distortion. this property of the base is known as dimensional stability. the base is of unifrom lucency and is nearly transparent to light so no unwanted patten or shading is found on the image

During manfucturinge howevre dye is added to the base of most radigraphic film to slightly tint the film bule. Compared with untinted film this coloring reduce eyestrain and fatigue, enhancing the radiologist's diagnostic efficiency and accuracy.

the original radiographic film base was a glass plate Radiologists used to refer to radiographic as x-ray plate Radiologists use. During world war I, high-quality glass become largely unavaible while medical application of x-rays particularly by the military were increasing rapidly.

A Substitute material, cellulose nitrate soon become the standard base. cellulose nitrate, however had one serious deficiency. It was flammable, improper storage and handling of some x-ray film files resulted in severe hospital fires during the 1920s and early 1930s lose triacetate, was introduced. cellose triacetate has properties similar to those of cellulose nitrate but is not a flammable.

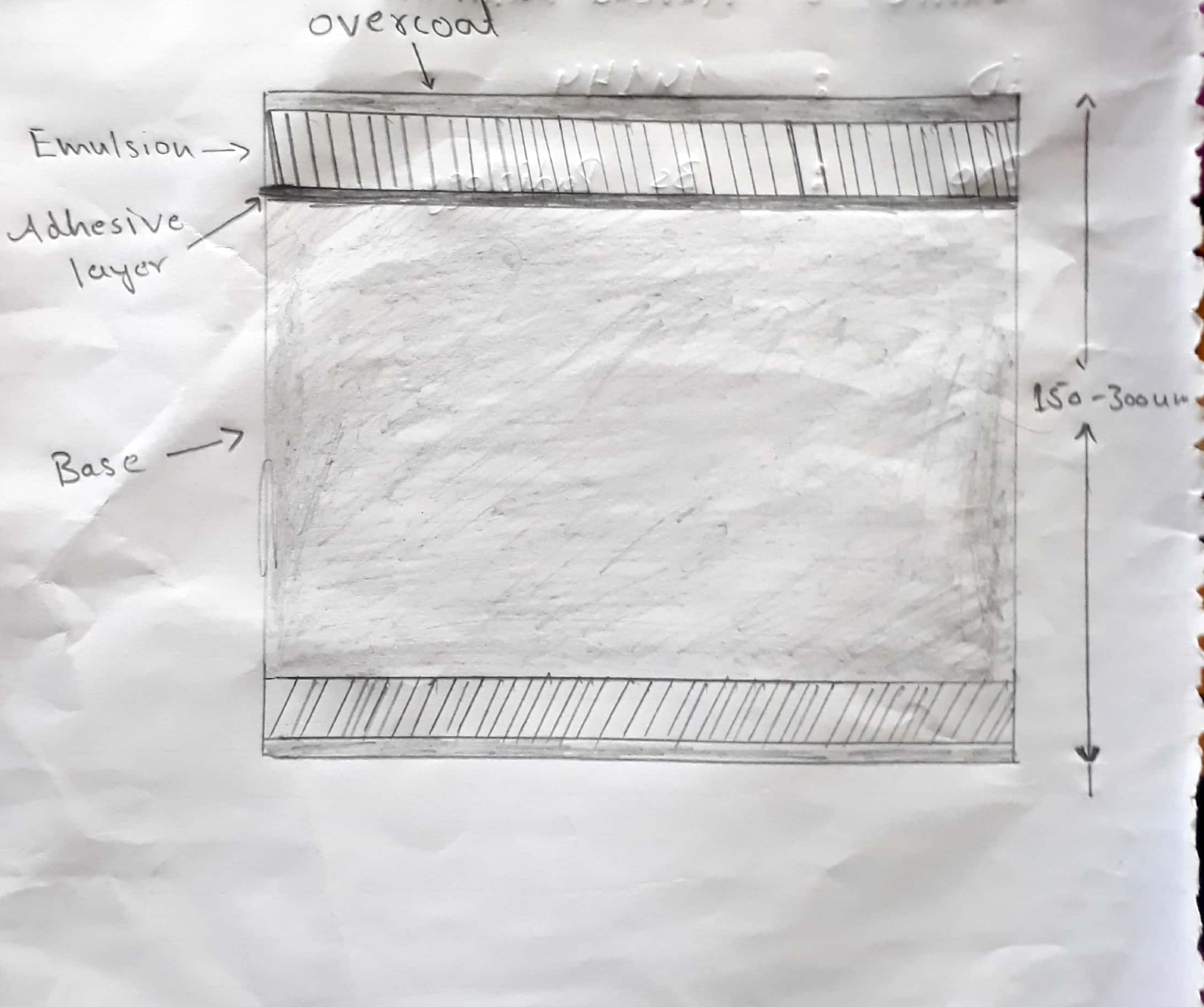
In the early 1960s a polyester base was introduced. polyester has taken the place of cellose triacetate has the film base of choice. ployester is more resistant to warping from age and is stronger than cellose triacetate premitting easier transport through automatic processore. Its dimensional stability is superior. ployester base are thinner than triacete may have tabular, cubic, octahedral polyhedral or irregular shape. Tabular grains are used in most radiographic film.

Tabular silver halides crystals are flat and typically 0.1 µm thick with a triangular, hexagonal, or higher order polygonal cross section. The arrangement of atoms in a crystal is cubic.

Difference in speed, contrast and resolution among various radiographic film are exposure, photoelectrons and silver are determined by the process by which silver halide crystal are manfacture and by the mixture of those crystel into the gelatin. The number of sensitivly centers per crystal, the concentration of crystals in the size and distribution of the affect performce charatcristic radiographic film.

Direct-exposure film contains thicker emulios with more silver halide crystal then screen-film. Radiographic film is together until final packaging. no light present.

Diagram of radiographic film :-



Scanned with CamScanner

Q1 Differentiate b/w calcium tungstate screens and rare earth screens?:

Ans Calcium tungstate screens:-

Using calcium tungstate (cawo4) and intensifying screens were compared in exposures of a pelvis phantom, and radiation doses were measured at several kilovoltages. using a slit a patten, the resolving power was assessed by a madified contrast-frequency response and by direct viewing of the radiographs in the comparison of the rare-earth and cawo4 screens the following differences were found ① A great reduction in the radiation dose can be achieved by the use of the fast screen type yet at the cost of some loss of resolving power. ② The film contrast can be improved by a reduction in the kilovoltage without an increase in the radiation dose. ③ The short exposure time and the characteristic course of the dose curve necessitate an adjustment of the phototime or a change of the control unit. ④ with the slower type tested the resolving power can be improved without increasing the radiation dose.

Rare Earth Screens:-

Newer phosphor material have become the material of choice for most radiographic applications. Table 13-3 lists these phosphor's and the general indentification of Screens into which they have been incorporated. Except for barium and Zinc-based phosphors the other new phosphore are identifed as rare Earth, therefore, all these Screen have come to be known as rare Earth Screens.

Rara Earth radiographic intensifying Screen are manufacture to perfrom at Several Speed levels up to 1200 This increas in speed is attained without loss of spatial or contrast resoulution, however with the fastest rare Earth Screen and can bee effect quantum mottle.

Rara Earth Screen provide a generl redution in the radiation envirument and when used exclusively can influence the design of radiographic facilities and redue the need for protective lead. Shielding.

This abrupt increas in absorption at this energy level is called the called the k-shell absorption edge and it is followed by another rapid reduction in photoeletic absorption with increasing x-ray energy.

Below the k-shell absorption edge for the rare earth elements x-ray absorption in higher in tungsten At an x-ray energy At equal to the K-shell electron binding energy of the rare Earth elemants, however the probability of photoeletic absorption is considerably higher than that for tungsten.

Each of the rare earth radiograpic intensifying Screens has an absorption curve characteristic of the phosphor that determine the Speed of the Screen and how it changes with kvp.

The result of this complex interaction process is that in the x-ray energy range b/w k-shell absorption edge for the rare Earth element and that for tungsten a rare Earth Screen absorbed.

Rara earth radiographic intensifying Screen exhibit better absorption properties than calcium tungstate Screen only in the energy range b/w the respective k-shell absorption edge. This energy reng extends from approximatly 35 to 70 keV and corresponds to most of the useful x-rays emitted during routine x-ray examination. outside this energy range, calcium tungstate radiographic intensifying Screens absorb more x-rays than rara Earth Screen
In cheet radiography for exam the front Screen/emulsion is Slower and higher in contrast and the back screen/emulsion is faster and lower in contrast The result is a move balanced image of wide latitude and high contrast over the lung fields and the mediastinum.