SNS COLLEGE OF ALLIED HEALTH SCIENCES- COIMBATORE 35

DEPARTMENT : RADIOGRAPHY AND IMAGNG TECHNOLOGY

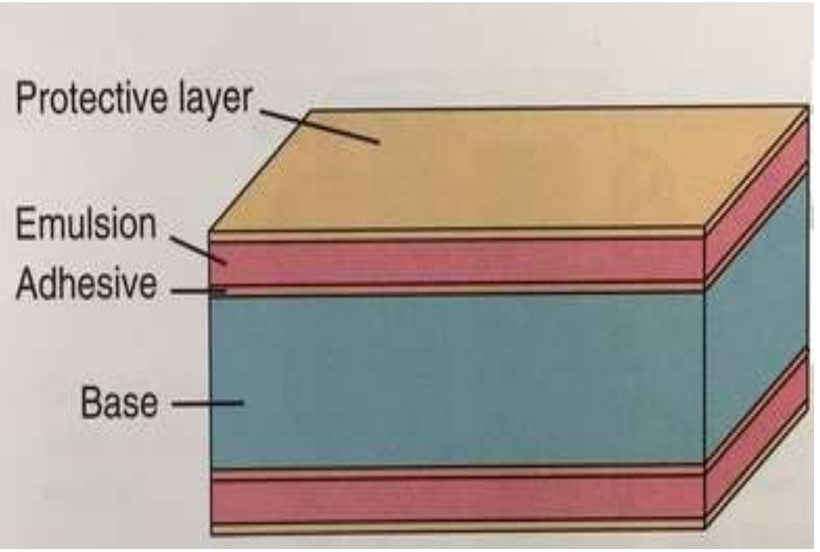
SUBJECT : GENERAL PHYSICS, RADIATION PHYSICS AND PHYSICS OF DIAGNOSTIC RADIOLOGY

PAPER : PAPER II

TOPIC : 1. STRUCTURE OF X-ray FILM

STRUCTURE OF X-ray FILM

- The transmitted X-ray from the patient should be converted into visible image to the human eye for interpretation. The device that does the job is called image receptor.
- The image receptors are X-ray film , fluorescent screen and solid state device.
- The medical X-ray film is used for capturing, displaying and storing radiographic images.
- It consists of (i) Base (ii) Adhesive Layer (iii) Emulsion and (iv) Overcoat.
- The emulsion is coated on both sides and hence it is called double side emulsion.

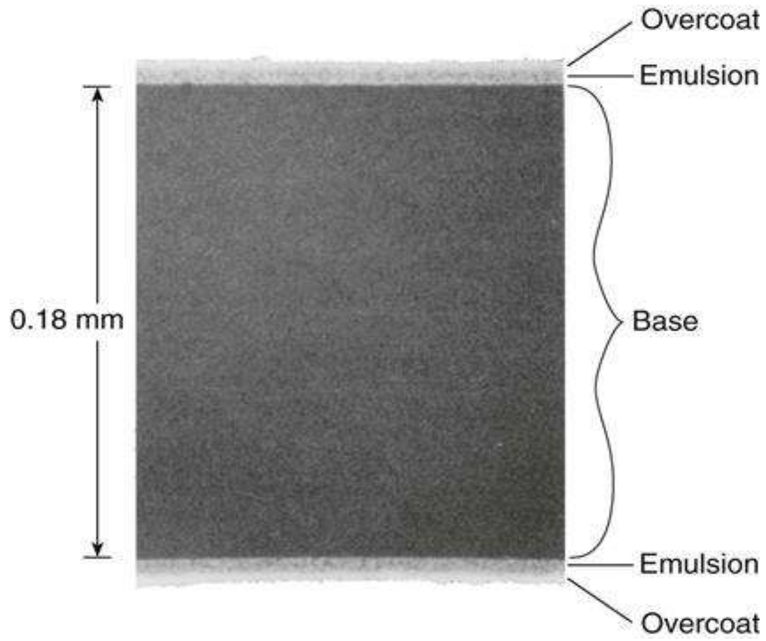


COMPOSITION - BASE

- The base gives a rigid support on which the emulsion is coated. It should be flexible, fracture resistant, and easy to handling without kinking. The base should have dimensional stability, so that it should not produce image distortion. It should have uniform lucency and transparent to light.it should be inert, so that the sensitometric properties of the emulsion are not affected.
- Initially, glass and cellulose nitrate were used as bases. Later (1920), the base cellulose triacetate (CTA) and polyester (1960) are being introduced. The polyester is made from polyethylene terephthalate resin. Polyester base is resistant to warping from age, stronger with higher dimensional stability. It is thinner in size (175µm)and easy to transport in automatic film processor.
- The X-ray film base is usually added with a dye, so that the film looks like blue. These films are called blue tinted, which reduces eye strain and fatigue. It gives pleasing appearances to the intermediate densities in the image and increases the diagnostic accuracy.

COMPOSITION – ADHESIVE LAYER

- The adhesive layer lies in between the base and emulsion, in the form of thin coat.
- It uniformly binds the emulsion to the base.
- It also helps to maintain proper contact between emulsion and base and provide integrity during film processing .



COMPOSITION - EMULSION

- The emulsion (3-5µm thick)is coated over the adhesive layer. Emulsion is consists of gelatin and silver halide crystal in a uniform manner.
- Gelatin is transparent to light and porous for chemicals. It gives support for silver halide, by holding them properly. among the halides, silver bromide (98%)and silver iodide (2%) is used as crystal in the film.
- These halides are flat and high atomic numbers, bromide (Z=35),silver (Z=47), and iodide (Z=53), compared to gelatin (Z=7).
- The halide crystals are available in tabular, cubic , octahedral, polyhedral or irregular grain shapes. Tabular grain shape thickness (0.1µm)is commonly used in radiography.

COMPOSITION - EMULSION

- The crystal formations are done in dark as follows; the metallic silver is dissolved in nitric acid, to form a silver bromide.
- **Ag** (metallic silver) + **2** $\boldsymbol{HNO_3}$ (nitric acid) → $\boldsymbol{AgNo_3}$ (salt) + $\boldsymbol{No_2}$ (gas) + $\boldsymbol{H_2}$ **O** (water)
- $\boldsymbol{AgNo_3}$(silver nitrate) + **KBr** (potassium bromide) → **AgBr** (silver bromide) + $\boldsymbol{KNo_3}$ (potassium nitrate)
- This is done in the presence of gelatin under given temperature and pressure conditions.
- The arrangements of an atoms in the crystal is cubic and lattice structure that has imperfections. These imperfections provide the sensitivity centers, for latent image formation.
- Direct exposure film has thicker crystals than screen type film. The film speed is controlled by size and concentration of the crystal.

COMPOSITION - EMULSION

- When the film is exposed to X-rays, photon interacts with bromine (photon + Br^- = Br + e^-)and releases secondary electrons .
- These interactions are either photoelectric or Compton type. These electrons migrate to the sensitivity center and get trapped.
- Mobile silver atoms (Ag^+) are attached to the sensitivity centers, where they combine with electrons and become metallic silver ($Ag^+ + e^-$ = Ag).
- The metallic silver atoms give latent image, which is invisible. Basically, the bromine and iodine are present at the surface, whereas silver is inside the crystal. mostly electrons provided by bromine and iodine atoms, resulting in collapse of crystal structure.
- As a result bromine and iodine are free to move to the gelatin area. No more ionic force is acting in the crystal.

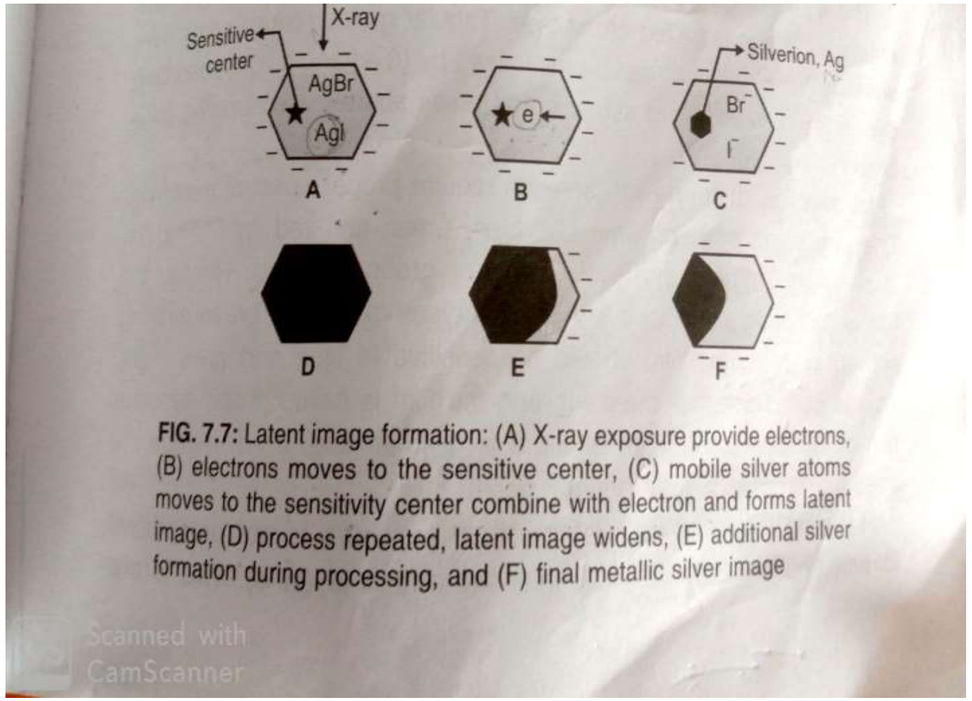
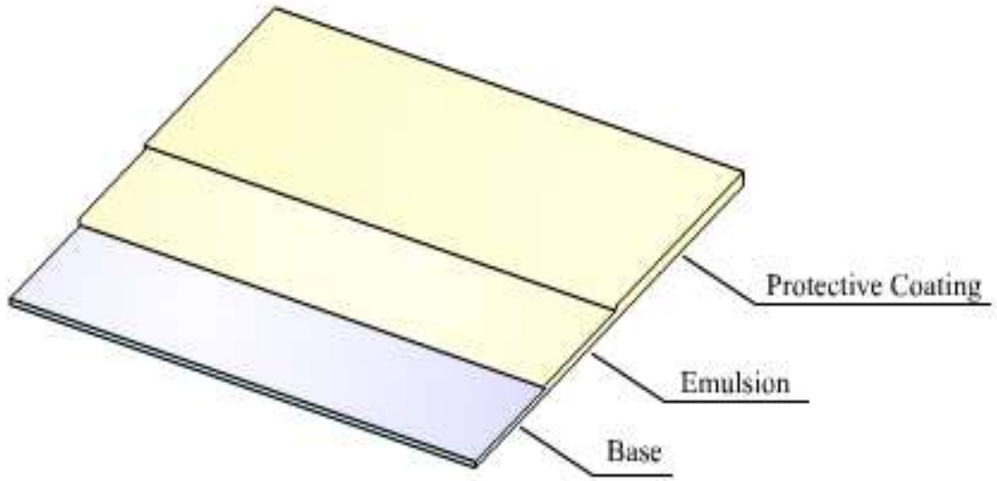


FIG. 7.7: Latent image formation: (A) X-ray exposure provide electrons, (B) electrons moves to the sensitive center, (C) mobile silver atoms moves to the sensitivity center combine with electron and forms latent image, (D) process repeated, latent image widens, (E) additional silver formation during processing, and (F) final metallic silver image

COMPOSITION - OVERCOAT

- The gelatin is covered by a layer called over coat. It protects the emulsion from scratches, pressure, contamination and handling damages



INTERROGATIONS

1. Composition of X-ray film
2. Base is made up of ?
3. Latent image formation
4. Difference between single and double coated X-ray film

REFERENCES

1. Radiographic latent image processing – W. E. J McKinney

2.Diagnostic Radiography – A concise practical Manual – Glenda J. Bryan (4th edn),

Churchill Livingstone

THANK YOU