Smile please, we're taking a picture!

by S.Ananthanarayanan

In the 19th century, photographs were wonders where astounding likeness resulted from a sitting of less than an hour! Today's pictures take a fraction of a second, but the principle, that light can 'reduce' silver salts to metallic silver, is the same as that of Louis Jacques Daguerre's discovery in 1830.

Metals and Salts

Many of us know that atoms have positive nuclei surrounded by negative electrons, distributed in orbits, as 'shells'. The outermost shell has 1 to 8 electrons, but to have 2 or 8 electrons is the 'stable' state. Atoms strive for this number in the 'give and take' of electrons during chemical combination.

In combination, metals, like zinc or sodium, 'yield'' or 'donate' electrons, while 'non-metals', like oxygen, or chlorine, 'accept' electrons, forging marriages like zinc oxide, sodium chloride and so on. The lighter metals, like sodium or potassium make durable liaisons, that resist 'decomposition'. But the heavier metals, like lead, mercury, silver or gold are less reactive and the links they form are easily broken. Thus lead is used in plumbing, to resist corrosion, and gold is known not to tarnish!

Silver salts respond to light

The metal silver, in particular, forms a loosely bound salt with iodine, with a bond that can be 'broken' by just a 'photon' or light particle. This is the quality used in the photographic plate.

The silver salt is embedded in a binding material like gelatin where the silver exists as 'ions', or atoms with a positive charge, due to the electron given up, alongside iodine atoms charged negatively, because of the electron accepted.

When a photon of light strikes the film, it knocks free an electron and leaves behind a positive 'hole', or a 'lack of an electron'. The electron 'set free' soon comes in contact with a silver ion. And there, the ion is neutralized into ordinary silver.

Latent image

The places where light has struck thus get a sprinkling of metallic silver atoms, while other parts stay as silver iodide. The traces of silver atoms now act as nuclei for a 'reducing' chemical to create larger, visible deposits of metallic silver. This is the process of 'developing' the latent image into clearly dark and light areas, the photographic 'negative'.

The unaffected silver iodide is then washed away with a solvent in the 'fixing' part of the process of 'developing' the film.

Slow and fast film

The ‘speck’ of silver needs to be at least 4 atoms wide. While each photon could start off one electron, the positive holes keep gobbling electrons and come in the way. Hence it takes 10 to 30 photons for a real dark spot, and the exposure process is only 10-30% effective.

Thus, for poor light, or for pictures with fast exposures, we have to use special film.

Recent advances

Jacqueline Belloni and her colleagues in the University of Paris are working on adding another salt, called a ‘formate’, which combines with ‘holes’ before the holes can use up electrons This may lead to films that take just over 2 photons, in place of 10 to 30, to darken a crystal!