Frozen Shadows

More Details

Phosphorescence freezes shadows

If light falls on a wall, the following happens: It arrives in individual portions, the light quanta. The electrons in the wall atoms "swallow" the energy of a light quantum and immediately "spit it out" completely – the wall reflects the light as usual.

Fig. 1: Light reflection on a surface: Light falls on an atom (1), which absorbs the energy and is thus excited (2), and then emits the energy again.

To enable the wall to emit an afterglow, its film is made of a special phosphorescent material – its electrons behave differently: they retain the swallowed energy for a while and spit it out again only after a short time delay – the wall continues to glow for a while after the flash. And, of course, it only does so where the light from the flash has arrived – where no body was standing in front of it. But it is a little more complicated: the electrons can only capture UV light that is invisible to us. So we could not actually see the afterglow, but the electrons do not emit the light as a whole but in two smaller, visible light portions. Our flash light also contains invisible UV light, which the electrons swallow and gradually convert into visible light.

Fig. 2: Fluorescent and phosporescent atoms emit incident UV light in two smaller light portions (3a and 3b) instead of as a whole, thereby transforming the energy-rich invisible UV radiation into less energy-rich visible light. Phosphorescent atoms emit the two light portions only after a while compared to fluorescent atoms.

Stamps, clocks and escape doors

Phosphorescent stamps make it easier to sort the letters: they are briefly exposed to UV light and the sorting machine can tell from the afterglow where the top right-hand corner of the letter is. It is then clear how the letter must be rotated to read the address field and where the postmark must go. It is obvious that clock-faces or escape-route signs often have a phosphorescent coating: when the light goes out they should remain clearly visible for a while.

What? Phosphorus does not phosphoresce at all?

The element phosphorus glows, which is why it is called "light carrier". When other substances were found that could glow "by themselves" after lighting, it was said that they "phosphoresce". But phosphorus glows because it reacts with oxygen from the air. This is a chemical process in which the phosphorus is consumed after a while. Phosphorescence, on the other hand, is a physical process and can be repeated as often as desired. Phosphorus and phosphorescent

substances do not therefore glow in the same way. But when scientists realised this, nobody wanted to change the name.

And then there was fluorescence…

Fluorescence works in a similar way to phosphorescence – with one difference: the electrons immediately emit UV light in two visible portions without time delay. If a fluorescent object is illuminated with invisible UV light, it radiates in visible light. If you switch off the light, there is no more glowing. Is the banknote genuine? Then its fluorescent fibres glow in UV light. In a disco, UV light (known as black light) makes T-shirts, bank notes, teeth and everything else that contains fluorescent material glow.