

Diamonds, X-rays and all that

It is sometimes said that diamonds don't show up on X-ray images. That's not true, as diamond smugglers can be caught in X-ray checks. However, it is true that, in the early days of X-rays, diamond rings could be distinguished from synthetic or 'paste' stones used in costume jewellery using X-rays. This is because of the chemical differences between the two.



Ernie the puppy swallowed a diamond ear-ring.

Paste is a form of glass, made by mixing together compounds containing lead, silicon, potassium, boron and arsenic. These elements mostly have high atomic masses and so they show up strongly in X-ray images. Diamond is different. It is pure carbon (see the article on pages 1-3 of this issue of Catalyst) and carbon atoms have an atomic mass of just 12. This means that they cast only weak X-ray shadows.



Jewellers traditionally check diamonds by eye but today more scientific techniques are needed to distinguish fakes.

Crystal structure

X-ray crystallography was used to show up the underlying atomic structure of diamond. Each carbon atom is tightly bonded to four others in a tetrahedral structure. This tight bonding means that vibrations travel rapidly through the crystal structure of diamond. Two consequences:

- The speed of sound in diamond is 12 000 m/s, twice as fast as in steel and nearly 40 times as fast as in air.
- Diamond is an excellent thermal conductor, with five times the thermal conductivity of copper.

Its high thermal conductivity explains why diamond is known as 'ice'. Touch a piece of paste jewellery to your top lip and it feels warm. Repeat with a genuine diamond and it feels cold as the warmth of your lip is conducted away.

Diamonds and light

Diamond has a very high refractive index (2.42, compared with 1.5-1.6 for most types of glass). It is also highly dispersive – it refracts blue light significantly more than red light. This gives diamond its quality known as 'fire' which you will notice if you see a cut diamond moving in the light.



Computer modelling determines how best to cut a stone from a rough diamond. Hand polishing is still used to give the most brilliant surfaces.

Light refracted by a diamond catches the eye.