New X-ray microscope for science and industry

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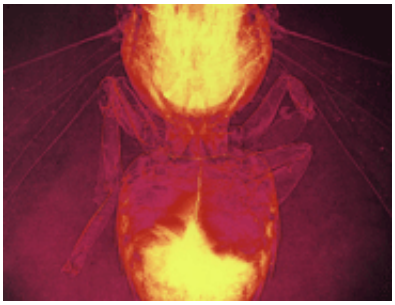

The X-ray phase-contrast image of a small fly.

Australian researchers have taken X-ray technology to a new level, developing and using high-powered microscopes to see inside objects and capture high-resolution images of their subsurface structures.

Until recently, X-ray technology was unable to achieve high-resolution imaging results at the microscopic level, particularly on objects with very weak X-ray absorption characteristics.

However, using powerful X-ray microscopes and experimenting with a variety of X-ray phase-contrast imaging techniques, scientists have been able to use the penetrating power of X-rays to directly image the internal microstructures of even opaque and multi-layer objects.

It is now possible to use X-rays to see inside objects such as micro-

electronic components, structural materials used in aerospace, ceramics, metal foams and even minerals.

“The uses are quite varied,” says Dr Steve Wilkins from CSIRO Manufacturing & Infrastructure Technology. “We have been looking at tissue scaffolds for growing new tissue, mineral samples and micro-electronic devices for major companies.

“We are also working on the study of bone properties, aerospace materials and intergalactic cosmic dust, and there is interest from the oil exploration sector looking at the porous structure of rocks.”

Using tomographic imaging techniques – which involve taking X-ray images from many different angles to create a three-dimensional image – it is possible to rotate and view multi-layers within an object to observe even minute imperfections.

Developed by researchers from CSIRO in conjunction with their spin-off company XRT Ltd, the X-ray instruments and methods are helping companies to develop stronger products, and to detect preliminary manufacturing defects before a company moves to full-scale production.

An X-ray ultramicroscope can deliver submicron resolution of the internal structures of opaque and multi-layer objects down to 50nm (one thousandth the diameter of a human hair), while phase-contrast imaging with commercial X-ray microfocus sources enables improved contrast with resolution down to about a micron.

New X-ray methods have been used in materials science, space science, life science, food inspection, microelectronics and geology.

As well as being used in areas such as biotechnology, there are also high-value applications such as in characterisation of micro-electronic devices

and materials being developed for next-generation energy production.

Source: CSIRO