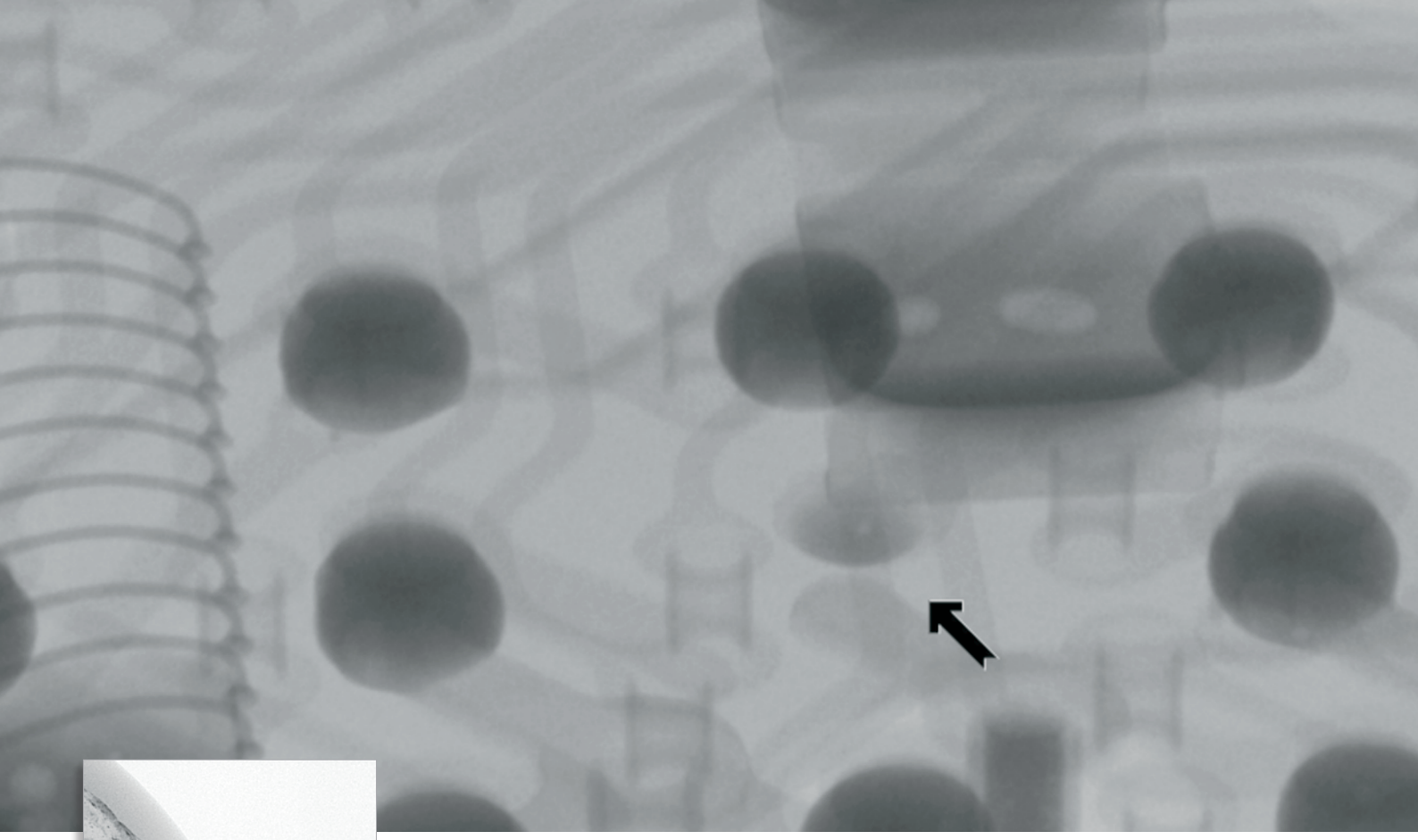

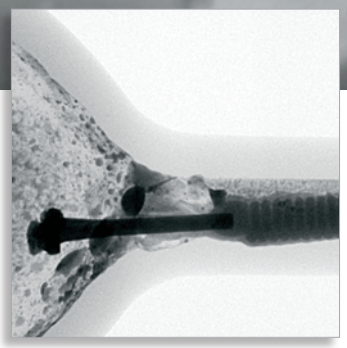

X-ray inspection

- real-time X-ray inspection
- 0.3 µm resolution
- 3-D imaging
- non-destructive

Real time X-ray inspection is a commonly used technique for non-destructive investigations of non-translucent samples. The system contains a microfocus X-ray tube with a small focal spot, allowing for high-resolution imaging. A CCD camera in combination with dedicated software enables digital image acquisition and detailed structural analysis within a time-frame of only a few minutes.

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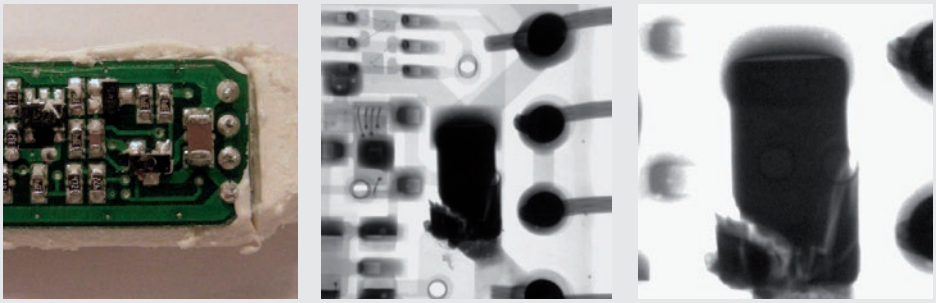

Optical photography image and X-ray images of a Printed Circuit Board (PCB). Inspection shows the malfunctioning component: the crack in the capacitor is clearly visible in the X-ray images.

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Principles of the technique

X-rays are produced in a high performance X-ray tube. The X-rays leaving the tube are projected onto an X-ray sensitive 2-dimensional detector, connected to a CCD camera. When an object is placed in between the tube and the detector, a 2-dimensional projection of the object is obtained. The contrast in the image is acquired by the differences in X-ray absorption of the different materials present.

3-dimensional studies

There are two possibilities to study an object in 3-D in XRT: using the so-called pseudo 3-D mode and tomography.
In pseudo 3-D, the detector is tilted with respect to the sample while imaging the sample in real-time. In this way, 3-D information is obtained on internal structures of the sample (see image on the front page). Parts of the sample that are first blocked by other parts in 2-D mode become visible now. In the front page image, interconnects below solder dots can be checked on their connectivity. (The arrow points at a missing interconnect).
In tomography, the object of study is fixed to a 360° rotation axis. Image acquisition during rotation results in a movie of the X-ray imaged, rotating sample. Dedicated software allows for 3-dimensional reconstruction of the internal structure of the object.

In-situ studies

The experimental set-up also allows for in-situ studies: electrical connections can be made to the product of interest. In this way dynamical processes can be followed. As an example: the migration of Hg in an UHP lamp has been recorded.

Applications:

X-ray inspection is frequently performed on a.o.
- LED's
- Various lamp types
- Printed Circuit Boards (PCB's)
- Electric components

Issues of interest:
- Internal fracture
- Internal corrosion
- Deposition of salts within a lamp
- Quality of seal
- Distribution of frit-glass
- Interconnects
- Voids
- Solder points
- Mechanical joints

Characteristics

Detail recognition
- < 0.3 µm

Magnification
- up to 10,000x

High Tension
- up to 160 kV

Sample preparation
- none

Sample restrictions
- max. 50 x 60 x 20 cm^3
- max. 5 kg

Field of view
- smallest: 900 nm in diameter
- 10 x 10 cm^2 for 3-D tomography
- 51 x 61 cm^2 for 2-D and pseudo 3-D

Sample manipulation
- 360° rotation
- up to 70° tilt for pseudo 3-D
- 3-axis translation (±300mm)

Non-destructive
- yes

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