

Microelectronic Device Inspection System

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In the laboratory of Technical Equipments for Non-destructive Testing (TSNK) of Moscow institute of Radioelectronics and Automatics there are making a systems for the technological inspection of printed circuit boards and its electronic components by methods of high-resolution roentgenoscopy and digital laminography and tomography [1].



Fig. 1 The system view from within

The inspection system consists of (Fig. 1): the X-ray protected box with door's locking; micro-focus x-ray generator and power supply unit with integrated control unit for maximal voltage 150 kV; X-ray detector (cooled CCD-camera TSNK or flat-panel X-ray detector of Varian or Thales); 2 drives to move the test object; 2 drives to move detector; drive of X-ray unit; remote control unit for all drives; computer to control the inspection system to acquire and process data; software «Diada». Optionally there can

be assembled high-precision drive for rotation of the test object to acquire the projection data for tomography.

The system has sizes 2000x2000x1700 mm and can test an objects with sizes 400x400 mm (the maximal thickness of objects from Fe is 18mm). It supports possibilities:

- inspection with geometrical magnification (from 2,5 to 50) of the X-ray images of the test objects with spatial resolution up to 20 mkm;
- automatic selection of the region of interest on the test object;
- checklist creation for automatic inspection;
- scanning of the lengthy objects with high resolution [2];
- reconstruction of the 3D internal structure of the test object by methods of digital laminography and tomography;
- digital X-ray image processing (16 bits per pixel): noise suppression, digital filtration, contrast enhancement, arithmetical image operations, image jointing, contour extraction and so on;
- full biological shielding of personnel in the work conditions;
- automatic search and recognition of the main technological defects of assemblage of electronic components on printed circuit board.

The system checking circuit is shown on Fig. 2.

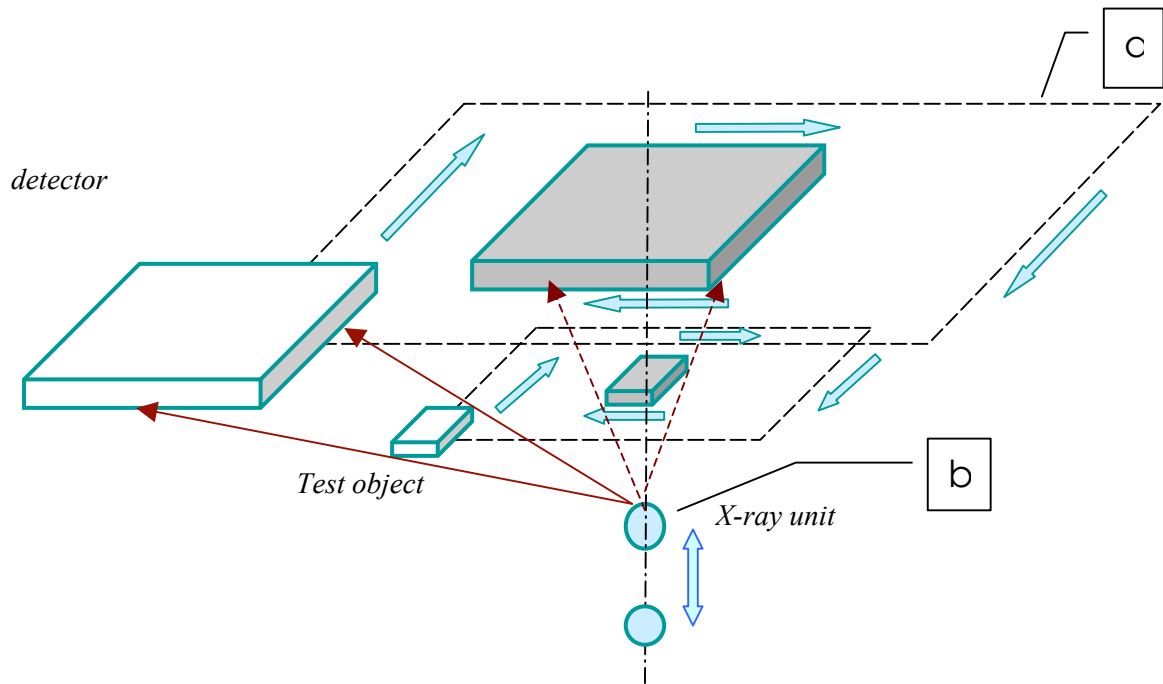


Fig. 2 The system checking circuit.

- a) The motion of detector and test object to acquire the projection data for digital laminography;
- b) The motion of X-ray unit to change the magnification factor of images.

The software of the inspection system can do the automatic analysis of quality of BGA and mBGA soldering by its X-ray images (Fig 3).

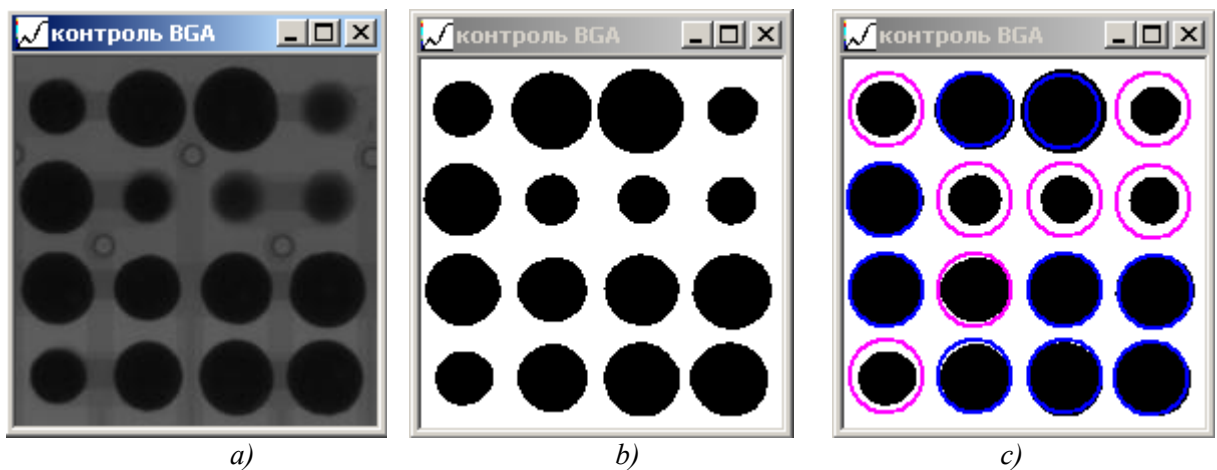


Fig.3 Steps of the automatic quality estimation of BGA- soldering.

- a) original digital X-ray image;
- b) the same image after digital filtering and binarization;
- c) the same image after recognition and quality estimation. Blue color marks the good contacts, red color marks the defect ones.

The digital laminography method reconstructs the 3D internal structure of BGA soldering (see Fig. 4).

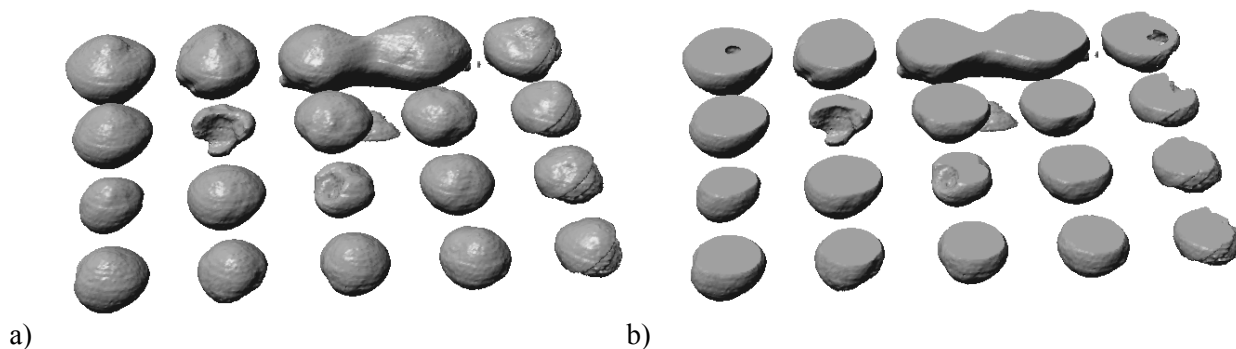


Fig.4 3D reconstruction of BGA- soldering. **a)** Ball's shapes **b)** Cavities within the balls

The described inspection system was successfully used to control: the critical components of the aero-space industry, welded and glued joints, cell structures, and small diameter tubes also.

The system advantages are: variety of the realized inspection methods, reasonable price (due to the components produced domestically) and gathering by customer requirements.

References

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2. Usachev E.Ju., Lebedev M.B., Chakhlov S.V. A Method to Sew The X-ray Images, 2006, N2, p.34-40