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AN AUTOMATIC MULTIPLE PIN LOAD TESTING SYSTEM BASED ON IMAGE PROCESSING AND MICROPROBES FOR IC-TESTING

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ABSTRACT

In order to develop integrated circuit (IC) testing, a new scheme was suggested using a microprobe array, a four-wire tester, machine vision, and motion control technology. The microprobe array can be automatically aligned with the IC die by an image-processing program in the system. Machine vision is used to denote software and programming implementations. The direction of IC packages can be determined by locating special features called notches or dimples, which are modeled on the IC packages. Several image-processing methods were combined and optimized to analyze the deflection angle, and the linear appropriate method was improved. Inaccurate fitting was eliminated by the modified Fitting method, and the arrangement error was significantly reduced. Finally, the efficiency of the microprobe automatic testing approach was confirmed. The open circuits of the ICs can be detected, and the resistance of the circuits, can be automatically measured and evaluated.

Keywords: ***Image processing, micro probe***

I. INTRODUTION

In the semiconductor industry, machine visions are extensively used in various stages of the IC device-manufacturing process. IC testing is one of the key aspects of IC manufacturing. With the expansion of high thickness and high-performance ICs, IC testing will face new demands and challenges.

Important progress in surface mount equipment has been made possible with the accessibility of IC devices in smaller packages, resulting in the capability to produce high-density printed-circuit boards (PCBs). However, the progress of automated final visual assessment based on machine vision technique has lagged behind that of IC packaging technology. This results in a high reliance of human attachment in the final visual inspection to ensure that the IC products are produced to a high degree of feature. The direction of IC packages can be determined by locating special skin texture called *notches* or *dimples*, which are molded on the IC packages. The notches and dimples are depression on the IC package that indicates the device's first pin.

Usually, the nature of a notch is a partial ellipse, while that of a dimple is a sphere, and their sizes vary for different IC packages.

Fig.1.IC notch

The contrast between the notch or dimple, and the rest of the IC package can be small, and varies depending on the texture and material of the IC package. This can make the notch or dimple difficult to detect using uncomplicated thresholding methods. To achieve microprobe automatic testing of IC dies, a test bed was integrated, which consists of a microprobe contest. According to a relationship between the pixels of the image and the rotation value of the die image can be obtained by using machine vision. The die is aligned with the microprobe fixture based on the offset rotation value.

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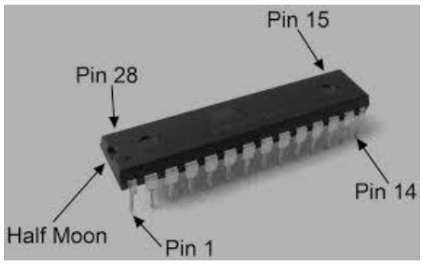

Fig.2.input and output pin

For covering die, the predictable testing method puts a only die into an IC test socket.. A microprobe of sockets contacts the die bumps, and the die limitation are considered. However, this is only a instruction manual and semiautomatic testing method. Recently, a 3-D stacked wafer covering is closely integrated with the front-end IC manufacturing by using the through-silicon-via (TSV) technology, implementing a multilayer included package. Traditional testing methods cannot gather the exact of the TSV development. [5] proposed a system in which an automatic anatomy segmentation method is proposed which effectively combines the Active Appearance Model, Live Wire and Graph Cut (ALG) ideas to exploit their complementary strengths.

It is critical to develop a new automatic testing method to improve the testing effectiveness after wafer-level packaging, and the wafer level automatic testing is a concern of the industry.

In this paper, an automatic testing system is the first to come together IC tests of wafer-level packaging by using the microprobe arrays, four-wire cable tester, machine vision, and motion control. The system automatically carries out IC testing with a considered control program. However, the automation of microprobe testing requirements to be further residential and applied to IC circuit testing.

II.PROBLEM STATEMENT AND RELATED WORK

The probe testing is essentially useful to the front wafer testing. For example, four-probe resistance assessment of wafers. With the development of the ICs, probe testing has also expanded to the package testing. For packaging die, the traditional testing method puts a single die into an IC test socket. A microprobe of sockets associates the die bumps, and the die parameters are measured. However, this is only a manual and semiautomatic testing method. Conventional testing methods cannot meet the demand of the TSV improvement. . Recently, a 3-D stacked wafer packaging is closely integrated with the front-end IC manufacturing by using thethrough-silicon-via (TSV) technology, implementing a multilayer integrated package.

III.SYSTEM SOFTWARE

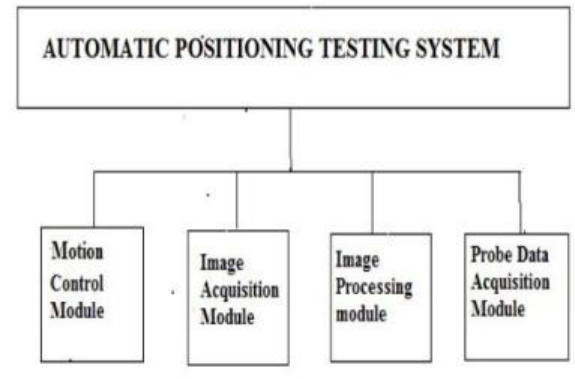

Fig.3.System software

An automatic testing system is the first to integrate IC tests of wafer-level packaging by using the microprobe arrays, four-wire cable tester, machine vision, and motion control. It consists of four modules

- ∑ Motion control module
- ∑ Image acquisition module
- ∑ Image processing module
- ∑ Probe data acquisition module

IV.FUNCTIONAL SCENARIO

A. Micro probe array

The microprobe array can be mechanically linked with the IC die by an image-processing program in the system.

B. Four wire tester

Four-Wire quantity makes it possible to accurately measure resistance values less than 0.1 Ω while eliminating the inherent resistance of the lead wires involving the capacity implement to the component being measured.

The compensation of 4-wire measurement come at a cost.

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First, the test system requires twice the quantity of test points that would usually be required for two-wire resistance measurement appreciably increasing the equipment cost. Second, test fittings must utilize two wires for every pin on the mating connector, one wire for the in growth source, and the other for voltage sense.

C. Machine vision

Machine vision is a term used to denote software and programming implementations that help in image processing. It is this Image dispensation property of machines that have also earned their sight the label of workstation vision. The facial detection technology is also another use of machine vision.

The scope of motion control is broad. Motion control is related to, though distinct from, computer vision.

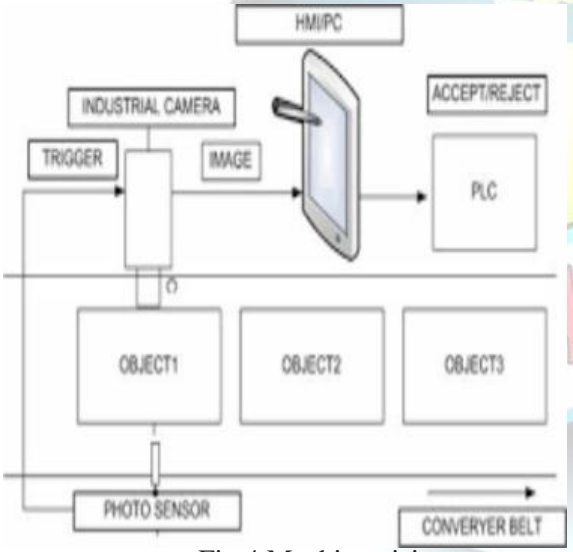

Fig.4.Machine vision

Machine vision is the technology and methods used to provide imaging-based automatic inspection and analysis for such applications as automatic examination, process control, and robot regulation in industry.

D. Motion control

Motion control is a sub-field of automation, nearby the systems or sub-systems involved in moving parts of apparatus in a restricted manner. The main mechanism concerned typically includes a motion director, an energy amplifier, and one or more main movers or actuators.

Common control functions include:

- ∑ Speed control.
- ∑ Position (point-to-point) control: There are more than a few methods for computing a motion trajectory. These are often based on the speed profile of a move such as a triangular profile, trapezoidal report, or an S-curve report.
- ∑ Pressure or Force control.
- ∑ This type of control is suitable for environment interface and object management, such as in robotics.

E. INTEGRATED CIRCUIT PROCESSING WAFER SAWING

In the context of manufacturing integrated circuits, **wafer dicing** is the process by which die are separated from a wafer of semiconductor following the processing of the wafer. The dicing procedure can involve scribing and breaking, mechanical sawing (normally with a machine called a *dicing saw*) or laser cutting. All methods are usually automatic to ensure precision and accuracy. Following the dicing process the individual silicon chips are encapsulated into chip carriers which are then suitable for use in building electronic procedure such as computer.

During dicing, wafers are typically mounted on dicing tape which has a sticky backing that holds the wafer on a thin sheet metal frame. dice tape has dissimilar properties depending on the dicing application. Once a wafer has been diced, the piece left on the dicing tape is referred to as *die*, *dice* or *dies*. Each will be packaged in a appropriate package or placed directly on a printed circuit board substrate as a "bare die". The areas that have been cut missing, called *die streets* are naturally about 75 micrometers (0.003 edges) wide. Once a wafer has been diced, the die will stay on the dicing tape pending they are extracting by die-handling equipment, such as a *die bonder* or *die sorter*, additional in the electronics assembly process.

- ∑ Ingots are then sawed into wafers approximately 500-1000 μm (0.5 to 1 mm) thick using a diamond tipped saw.

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- ∑ Wafers are the starting material for integrated circuit manufacture, and are normally referred to as the substrate
- ∑ Surface of the wafer is curved with grouping of chemical and mechanical polishing steps

F. Automatic positioning testing system

When the IC die is moved under the CCD camera by the motion control module, an image of the die is captured by the image acquisition module. The coordinate and angles of the middle of the quadrangle will be considered next by the image-processing module.

Then, the IC die will be associated to the microprobe array by the motion control module according to the result of the image-processing module. After the collection is done, the microprobe array will move down to make contact with the electrodes of the tested IC. At last, a testing circuit is created, and the four-wire cable tester tests the electrical properties of the IC and displays all the consequences.

All through the initialization process, the system ensures that the worktable backs to zero and sets the default consideration of the distance between the CCD camera and the microprobe contest.

Second, the motion control module moves the IC die under the CCD camera that will confine an image of the IC die.

Finally, quadrangle center point coordinates and the angles of the object characteristic are obtained by the MATLAB image processing.

Motion control system controlled by the 4-axis motion controller, includes X, Y, Z three-rail and rotational movement, to achieve automatic alignment. CT8700 four-wire testing machine whose accuracy of resistance test is 0.1 was applied in electrical performance tests. The alignment and testing was controlled by LabVIEW program.

IC characterization and testing developed with the use of bench-top equipment.. These instruments have provided and continue to provide high performance and flexibility of use; both characteristics are very important during the characterization and debugging phases of IC development.

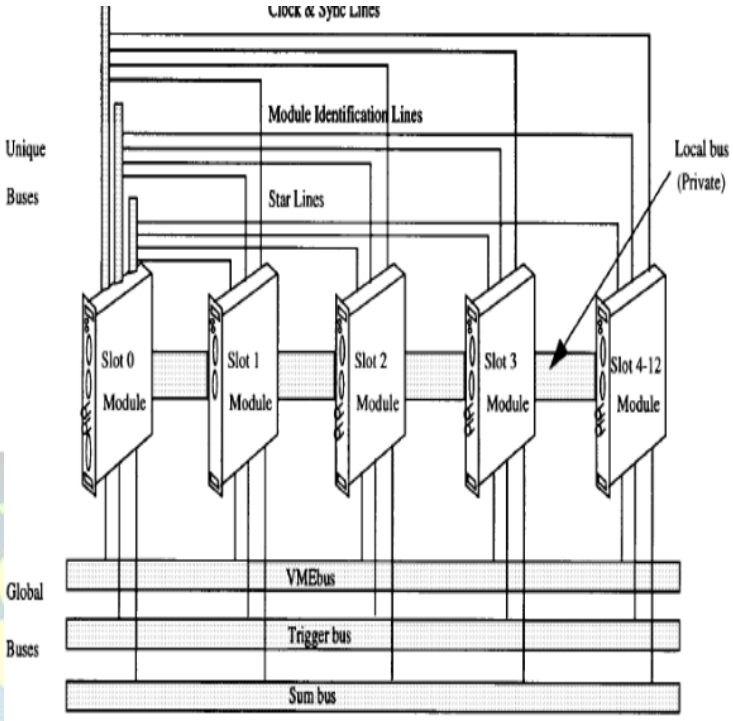

Fig .5.line and bus configuration

At the simplest level, one instrument may trigger or control the instrument supplying the stimuli to the DUT or it may control the intervention of other measuring instruments.

V.RESULT AND DISCUSSION

For the actual imperfection detection in IC, image gray scale is dissimilar because of the impact of intensity. Some images are clear and some images are dim, and it is a confront for detecting defects in IC. In order to remove the normal image from the images of dissimilar intensity, one of the two images with defects is regarded as a location. We match the histogram of one more image with that of the location, and the intensity of the two images with defects is unified. The influence transform contributes a lot to the imperfection separation by repeated threshold processing. Sometimes, the normal image is very complex to achieve, the method accessible in the paper can solve this problem simply.

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VI.CONCLUSION

A novel automated multiple pin load test system is proposed, which is based on a microprobe array, a four-wire cable tester, machine vision, and motion control technology. The position of the microprobe and IC die is realized using the machine vision technology. As a result, the system can automatically present the die arrangement and electrical testing, which can be useful to the industrial testing.

Similar technique can be used to consider other molded features on IC packages and can also be adopted for assessment processes in the automatic assembly of other small electronic mechanism.

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