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NASA TECH BRIEF

Marshall Space Flight Center

Laser Scanner for Testing Semiconductor Chips

The problem:

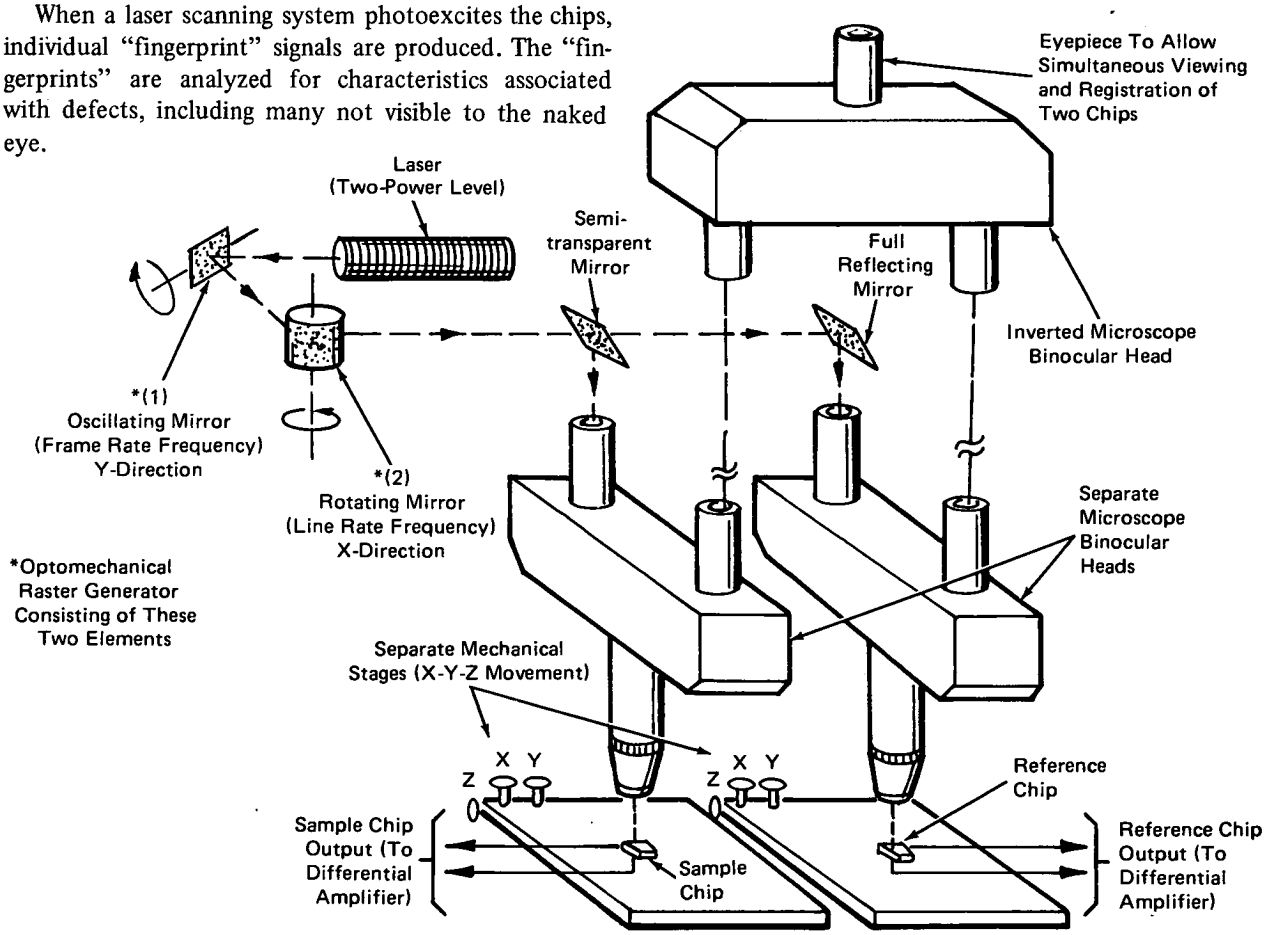
In general, semiconductor chips are examined visually before capping. This method successfully screens out bulk surface defects. However, visual examination is subject to human error and provides no means for discovering flaws not connected with surface irregularities.

The solution:

When a laser scanning system photoexcites the chips, individual "fingerprint" signals are produced. The "fingerprints" are analyzed for characteristics associated with defects, including many not visible to the naked eye.

How it's done:

Electromagnetic radiation photogenerates free electrons and holes in a semiconductor chip. These carriers produce electrical signals at the terminals. The signals vary depending on what defects are present. In this system (see figure), the electromagnetic radiation is supplied by a two-power-level laser. A high-power mode excites the chip, and a low-power mode generates a final



Optomechanical Arrangement for the Laser Scanning System

(continued overleaf)

display. The laser radiation is rasterized, and the signal from the chip appears as a raster on a cathode-ray tube (CRT).

The laser generates a raster by two rotating mirrors. The beam is split and directed to one eyepiece of each of two separate pairs of binoculars. The binoculars focus the beam on the sample chip and on a reference chip where it stimulates an electrical signal. A third pair of binoculars is used visually to align the chips.

The "fingerprint" of a device will vary with the leads that are selected for output; each pair of leads has its own characteristic CRT display.

The signal from the two chips is processed by a differential amplifier, the output of which intensifies and modulates the raster on the cathode-ray tube. In the unlikely event that the chips are precisely the same, the amplifier will have a zero output; otherwise, the greater the chip difference, the greater the signal. The actual reference chip may be replaced by a computer program, and an automated examination can be performed in exactly the same manner for each chip.

Note:

Requests for further information may be directed to:

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Patent status:

Inquiries concerning rights for the commercial use of this invention should be addressed to:

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