Секция 6

СТАНДАРТИЗАЦИЯ, МЕТРОЛОГИЯ И ИНФОРМАЦИОННЫЕ СИСТЕМЫ

УДК 621

RELIABILITY ANALYSIS OF A NEW PROBE CARD TECHNOLOGY

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Circuit testing is an absolute requirement in the semiconductor fabrication industry. The sooner (in the fabrication process) a failing die is discovered, the lesser is the economical loss. Probe cards are employed in testing dice onto unsingulated wafers. A probe card is an electro-mechanical interface between test equipment and the silicon die (the device under test) and is composed by a stack of mechanical and electrical layers whose task is to make a reliable contact onto bonding pads (or bumps), deliver power and test signals to the die and deliver die response to the tester. As wafer probing is a consuming task, it must be done reliably and efficiently. The most important reliability parameter for a probe card is the resistance change of a trace with the number of touchdowns. This change is due to the accumulated material onto the probe tip. Aluminium bonding pads are covered by 60 nm native oxide (alumina) that must be scrubbed to provide a reliable electrical contact. The alumina removed from pad surface accumulates onto the probing tip and makes up a thin resistive layer that raises the total resistance and wear (by mechanical action) the tip itself. The electrical active layers in a probe-card are a multilayer printed circuit board (PCB) and the contacting structure, usually a high density PCB built on a ceramic substrate. The resistance budget is usually equally split between the two structures and total trace resistance must be below 5 Ohms for signal traces and 0.5 Ohms for power delivery traces, and that limits must be enforced during all the probe card operation cycle.

Due to the low resistance of power paths (~0,2 ohm), the low level of injected current (<1mA), and the different materials of the contacting and setup wires, we were forced to remove the effect of thermoelectric voltages "Vemf" (in series) applying the current reversal process. We made two measurements for each tip and each touchdown, reversing the direction of current to cancel the effect of thermoelectric voltages (that do not change polarity with current) and taking the mean to extract resistance:

$$V_{m1} = V_{emf} + IR;\ V_{m2} = V_{emf} - IR.$$

$$V_m = (V_{m1} - V_{m2}) / 2 = IR.$$

$$R = V_m/I.$$

References:

Low Level Measurement Handbook, 6th edition, Keithley.