Real-time Validation of Probe Contact Quality in GaAs PCM Testing

Martin J. Brophy, Phil Marsh, Anthony Martinkus, and Judy Huggenberger
Avago Technologies, 4380 Ziegler Rd., Fort Collins, CO, 80525 U.S.A. martin.brophy@avagotech.com

Keywords: PCM Test, Contact Resistance

Abstract

Process Control Monitor (PCM) test of GaAs wafers can be validated in process by monitoring the actual probe contact resistance of each tip on its probe pad. We present our method for doing that using an existing PCM test track to validate the test and prevent excessive retest.

INTRODUCTION

In-fab final PCM test of GaAs IC wafers is usually done on gold bond pads using Be-Cu probe tips in a cantilever probe card. The quality of the test is critically dependent on the quality of the probe to pad contact resistance, especially for measuring low resistances. That can be impacted by damaged probe cards, by debris on the probe pad, or by incompletely opened pads. Too often, probe contact failure is only seen after completion of lot testing, leading to fab lots on hold and to the need to retest, adversely affecting cycle times. Moreover, frequent poor probe results lead to a loss of faith in the quality of PCM test by the wafer owners.

We have developed a method of using an existing PCM module to actively demonstrate solid probe contact before completing test of any site on the wafer. Active real-time responses to poor contact like probe cleans or probe card replacements can then be done so that all completed PCM tests can be shown to be correctly executed, removing bad test as a suspect in why a wafer failed PCM test.

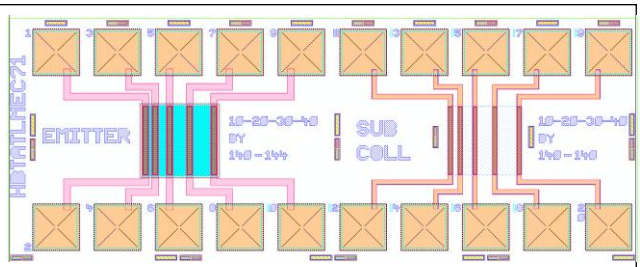

Fig. 1. Transmission Line and Probe Pad Check Track.

BACKGROUND AND RESULTS

Avago Fort Collins uses a 2 x 10 pad "track" for doing PCM test. Process test structures for active and passive circuit elements are positioned inside the rather large space between the rows of pads. One of those structures is shown in Fig. 1, a transmission line used to measure HBT epi layers in a 4 point or Kelvin test.

Fig. 2 shows that by injecting current Ip into pad 3 and

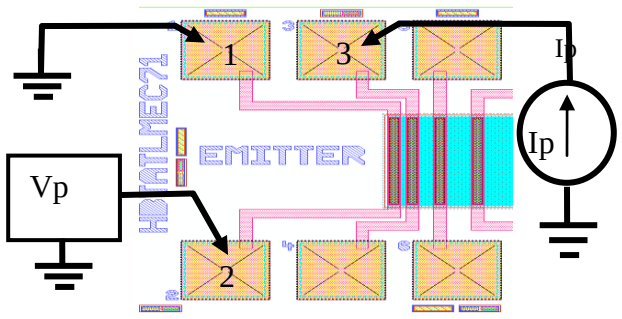

Fig. 2. Close-up of Pad 1 Probe Resistance Measurement.

sensing the voltage Vp on pad 1 with a high impedance probe on pad 2, we can assess the probe – pad contact resistance Rc with acceptable accuracy. Data from this test shows a typical Rc of about 0.2 – 0.3 Ohms, as shown in Fig. 3, which also shows there is a higher Rc tail for some probe tips, clearly an area for further study.

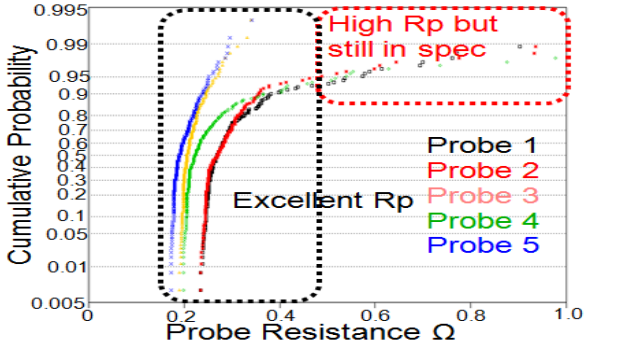

Fig. 3. Statistical Results of Probe Pad Check of Five of our Twenty Probes.

IMPLEMENTATION

The current method of using the probe pad check (PPC) in routine production PCM test is to follow the procedure below for each wafer in a lot.

1. Start new wafer with passing PPC on first site, clean tips or replace card until pass.
2. Test all PCM tracks on site

3. Do PPC. Record site data if passed and go on to step 2 for next site or exit if last site.
4. If PPC failed, perform brush clean. If PPC now passes, return to step 2 on the same site, unless two cleans were performed already on that site.
5. If two cleans did not help, note the site as PPC bad, record that site's data and go to next site. We do not just stop after one fail to protect against a defective PPC test track, which should rarely or never happen.
6. If two die in a wafer are PPC bad, the wafer is PPC bad. In this case, stop test, note wafer ID of the PPC bad wafer, replace probe card and restart lot at the PPC bad wafer which had stopped testing.
7. If the same wafer fails PPC again, after replacing the probe card, put the lot on hold for test engineering intervention.

This procedure allows only site data we have validated (or for sites believed to have a defective PPC track) to go into our PCM database and provides information to avoid the almost automatic response in many fabs to PCM fails – "retest the wafer/lot with a different probe card and/or on a different tester." A passing probe pad check proves there was nothing wrong with probe placement or probe contact quality on the site just tested, removing the reason to retest.

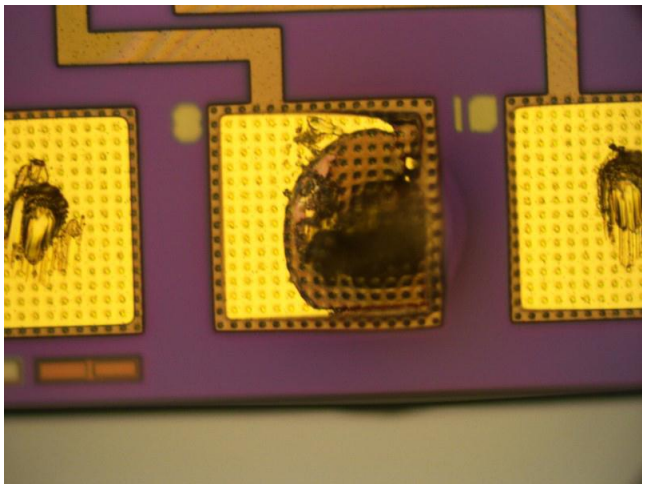

Fig. 4 Example of Pad Residue Detected by PPC

Furthermore, we can extract the recorded value of individual probe Rc from any PCM measurements of low resistance, improving the tested value by removing that parasitic component. And this can detect fab problems like residue on probe pads, as illustrated in Fig. 4.

CONCLUSIONS

Automated validation of probe contact quality has been installed using an existing PCM track in a GaAs production line. Active intervention is initiated automatically in several common scenarios. This has led to more reliable and consistent PCM test data and improved confidence in our PCM test results.

ACKNOWLEDGEMENTS

The authors would like to thank Alan Bratschun for his help in formulating this test.

ACRONYMS

HBT: Heterojunction Bipolar Transistor
PCM: Process Control Monitor
PPC: Probe Pad Check