IEEE SW Test Workshop

Semiconductor Wafer Test Workshop

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Probe-Tip Clean On Demand

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Introduction

- Today Probe-tip clean settings are static
- Clean interval is every x-dies or x-wafers
- How to determine the right settings?
- Not enough cleaning can cause yield loss!
- To often cleaning will “eat-up” your tips
  - When abrasive scrub is being used
  - Above all; it will cost time!
- Best would be;

Introduction

But this is not realistic,
we are stuck with Probe-tip clean !

Background

- Case study for one of our customers;
  - Customer currently uses clean interval every 100 die (worse-case setting)
  - Customer is testing the most wafers (80%) at elevated temperatures
  - As soon as probe-tips “leave” the wafer, a probe-tip soak is required before proceeding
  - Clean cycle takes ca. 5 sec
  - Soak cycle takes 120 sec (worse case setting)
  - Total cycle 125 sec!

Background

- Can we detect when cleaning should be done?
  - Wait until fails show up is not the way!
- Could we monitor the real-time parametric data and respond if a trend is detected?
  - Trend should be; values raise or fall in consecutive order
  - A threshold value should be set to initiate the clean moment

Objectives / Goals

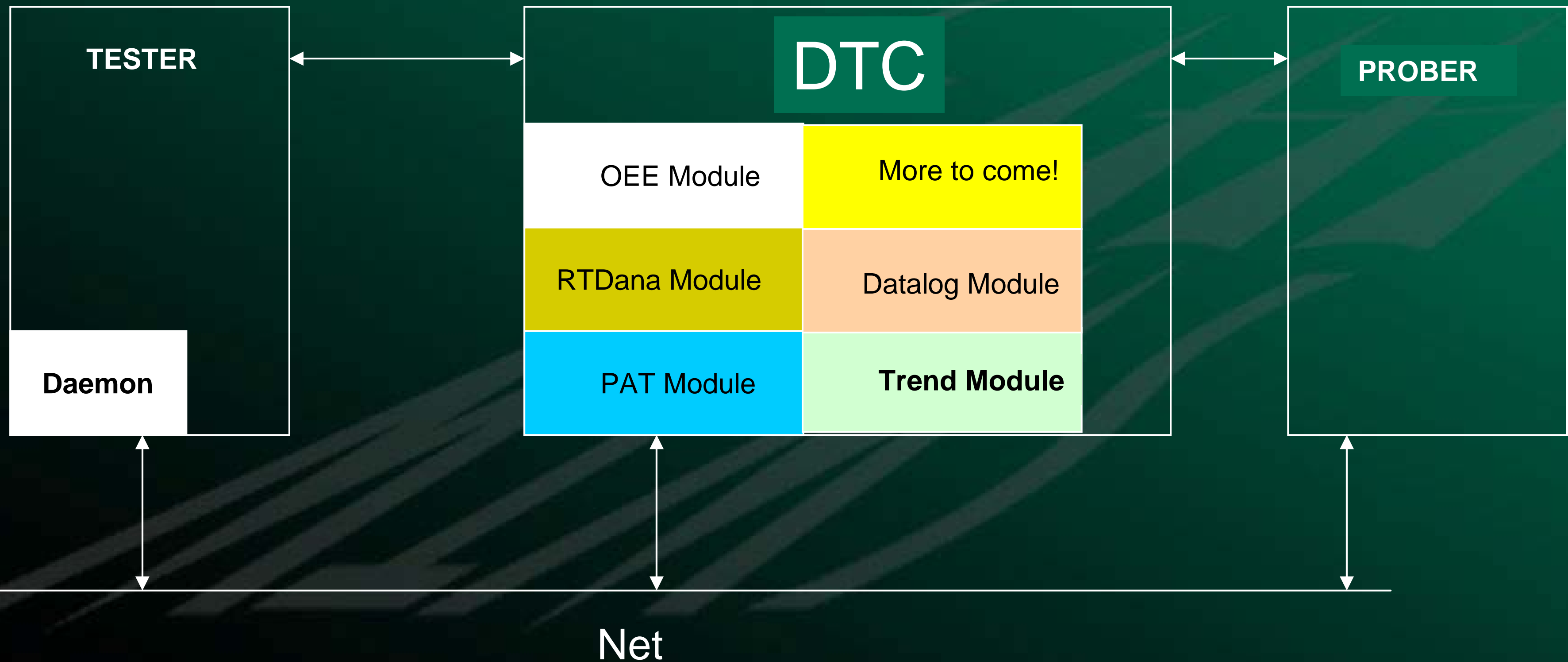
- To clean only then when it is necessary
- Every reduction of a clean cycle will also reduce a “soak” cycle!
- The clean on demand should lead into total wafer process time reduction.
- Save probe-card life-time (scrub)

Methods / Materials / Procedures

- Equipment set-up
  - Wafer prober Electroglas 4090
  - Test system Spea 370
  - **D**ynamic **T**est-cell **C**ontroller
  - Tester Daemon Atos C2

Methods / Materials / Procedures

From SE-PROBE to a Dynamic Test-cell Controller



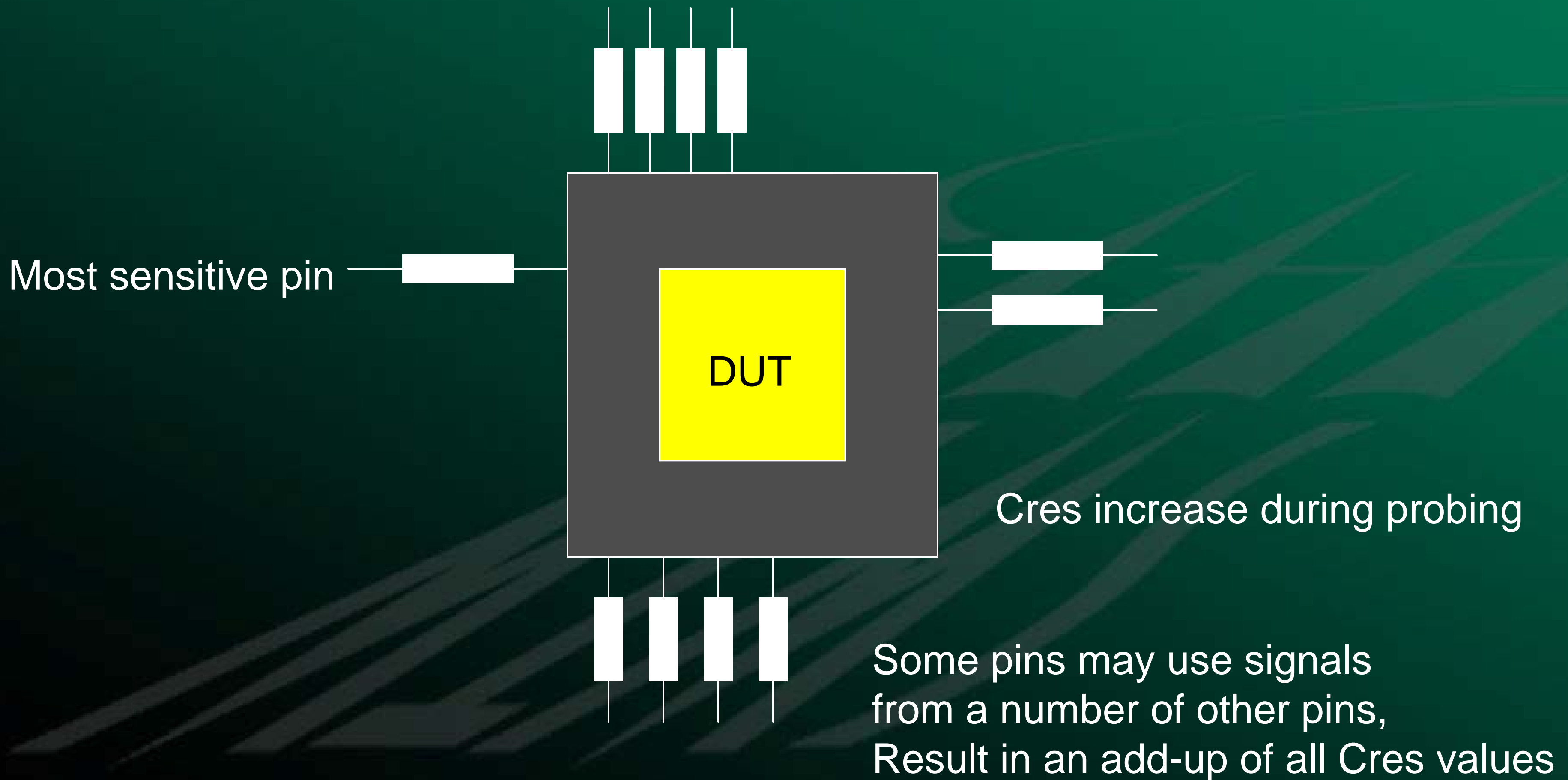
Methods / Materials / Procedures

- When to clean?
  - It does not matter how many needles you have, if only one requires cleaning; You have to clean the entire probe card!
- On almost every “pin” a contact-test is performed at the start of each test-cycle
  - Should we monitor all those tests and if one of them shows a consecutive increase of value; perform a clean?

Methods / Materials / Procedures

- Still remains those “pins” where no real contact test could be performed!
- We also know that some higher current carrying pins show Frittering, which could “burn” the dirt.
- Increase of C-res shows at most contact sensitive test
- So what would be the best suitable method?

Methods / Materials / Procedures



Methods / Materials / Procedures

- Almost every device has got a most sensitive pin for “good-contact”
- How to detect this pin?
- Start with a “good” set-up on the prober
  - Acceptable probe marks (Z-height control)
  - Good test results (bin 1 part)
- The DTC will start the first fail algorithm;
  - The Z-stage (chuck) is lowered a small steps
  - Test is repeated
  - This continues until the first fail occurs

Methods / Materials / Procedures

Methods / Materials / Procedures

- For the first test generating a fail;
  - test-number is stored.
- This “search” for the first failing test is now repeated a few times on the same die and a check is performed on repeatability of the results. The found test(s) is(are) classified as the “most contact sensitive test(s)”
- The next step is to repeat the “search” on a few more die locations.

Methods / Materials / Procedures

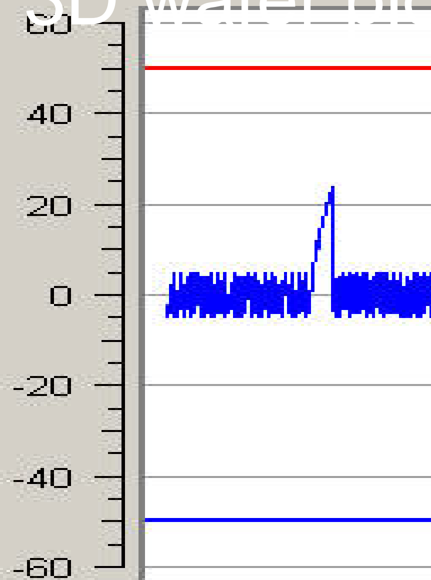
- Alternative method to detect contact sensitive tests:
  - Test wafer without cleaning
  - Analyze tester datalog file
  - Look for those tests which show increase trend after a while
- Even when cleaning is used at static setting;
  - It should be visible to see the value “resetting” after each clean

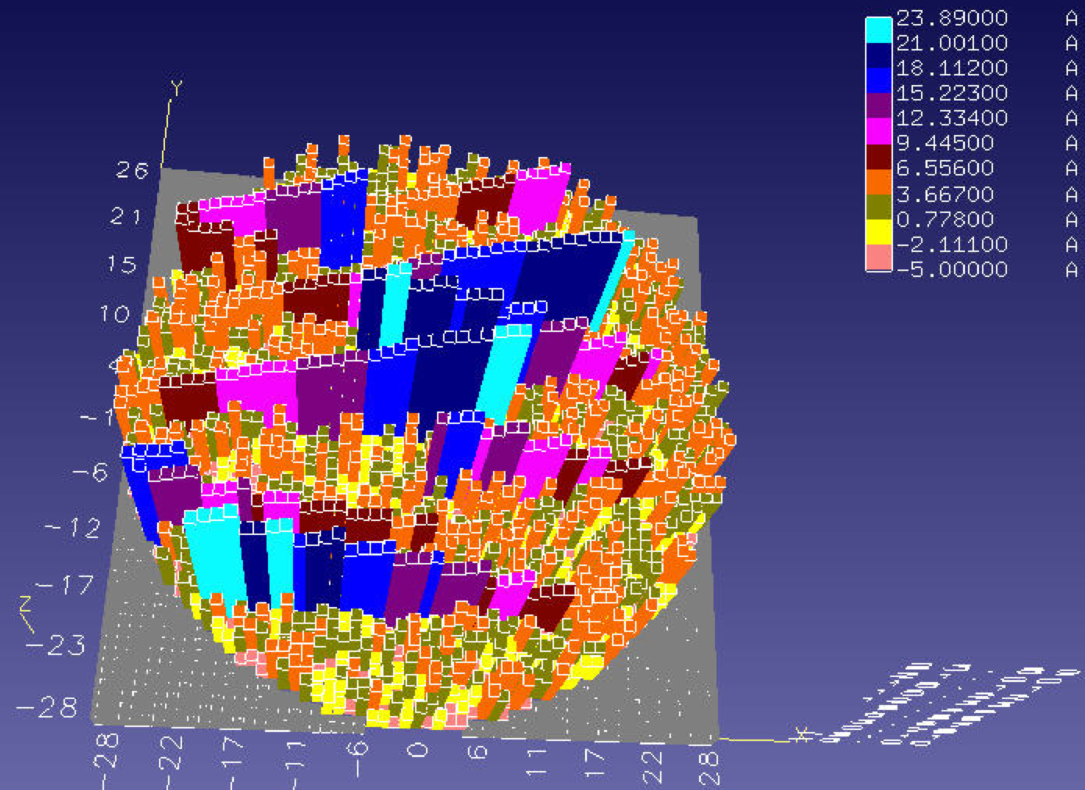
Methods / Materials / Procedures

- After analyzing the gathered data; the clean recipe can be generated;
  - Test number(s) to monitor
  - Per test number the threshold (should be set before real failures occur)
  - Minimum clean interval to get rid of the debris (even if this does not harm the test results)
- Cleaning on demand now takes place when the selected test(s) show consecutive increase/decrease in value plus go trough the threshold level.

Results / Relevant Findings / Key Data

- Examples data analysis
  - 2D Line plot
  - 3D wafer plot





Results / Relevant Findings / Key Data

- How does it work in practice?

Results / Relevant Findings / Key Data

- Original clean interval: every 100 die
- Clean cycle: 5 sec (clean unit)
- Soak time: 120 sec
- Savings results based on 30% clean cycle reduction
- On type E in next table no soak time (ambient test)

Results / Relevant Findings / Key Data

type	die/ wafer	clean cycles	Clean time	Test time	clean in %	Saving in %	avr time per die; test + index
A	1016	10	1250	22628	5.23	1.57	22.27
B	11320	113	14125	16200	46.58	14.01	1.43
C	1217	12	1500	1393	51.85	17.28	1.14
D	478	4	500	3539	12.38	3.09	7.4
E*	1745	17	85	5520	1.52	0.45	3.16

Discussion of Results

- Test-cell requires a DTC
- A tester Daemon should be available
- Clean on demand is dynamic process
- Reduction on clean cycles
- No yield concession
- Soak time has massive effect on total process time
- No clean-wafer has taken into account yet!

Strengths

- Clean only then when necessary
  - Based on device specific recipe
  - Real time parametric data monitoring
  - Depending on amount of debris, causing increase of Cres, probe-card live time is expanded due to less clean cycles.
  - DTC can do in the same time a lot of other actions and control (not limited to dynamic clean)
  - Reporting, know where in the map clean took place
  - Probe card Dbase including yield and clean history

Weaknesses

- Each product requires a clean recipe
  - Find the most Cres sensitive pin(s)
- Recipe creation requires engineering skills
- Additional hardware/intelligence is required per test-cell
- Perhaps the recipe should be linked to the probe-card?

Summary / Conclusion

- It is possible to dynamically control when probe tip clean is needed by adding a DTC
- Depending on quality of product, total process time reduction has been achieved.
- The shorter the test time the higher saving results were achieved.
- Reduction of clean cycles also reduces the amount of soak cycles when test at high temperatures. (in fact this is most of the saving)

Follow-On Work

- Gather more real data to make a even more clear statement.
- Come up with “Plug and Play” recipe creation.
- Work out the detail when “clean-wafer are being used i.s.o. clean unit next to chuck.
- Focus on soak time control, don’t soak longer then necessary.

Thank You

- Let us clean on demand!
- Questions?