

~ Table of Contents ~

TAB 1— Introduction / Overview

Authors / Contributors
David L Burgess
Richard A Blanchard

TAB 2— The Process & The Approach

Scope
Yield in Integrated Circuit Manufacturing
Failure Analysis Sequence
Problem Solving Logic

TAB 3— Yield Reduction Mechanisms

Yield Reduction Mechanisms (Introduction)

A— Design (including Test Structures)

Bipolar Snapback and Second Breakdown in MOSFETs
Latchup
Transistor Symbols and Terminology
EOS and ESD in Integrated Circuits
Layout Sensitivities
Passivation Faults
 Example...
 Keyhole Fault
Hot Carriers
Stress Induced Voiding
Electromigration in Metals
Contact Spiking

B— Process

Pipes and Precipitates
 Examples...
 Collector Leakage
 Short Channel Effects
Pits
Autodoping
Kooi Oxide
Plasma Induced Charge Damage
 Examples...
 Capacitor Shorts
 Test Structures for Plasma Charging
Implanter Induced Charge
Managing Plasma Damage
Reprint: from Wafer Charging Monitors, Inc.
"Using CHARM[®]-2 to Quantify Wafer Charging in Ion & Plasma-based IC Processing Equipment"
Charges in Dielectric Layers
Ionic Charge
Particles

- Mask and Etch Issues
 - Masking Issues
 - Alignment
 - Photoresist
 - Examples...
 - Photoresist Coverage
 - Exposure and Develop
 - Reflective Notching
 - Proximity Effects
 - Etch Issues
 - Poisoned Vias
 - Oxide Etch Polymer
 - Examples...
 - Open Vias
 - Onion Rings
 - Metal Etch Polymer
 - Example...
 - Corrosion Cotton Balls
 - Stringers
 - Examples...
 - Residual Material In Crevices
 - Material Trapped Under Ledge
 - Residual Poly 2 Causes High L_{eff}

C— Assembly

- Assembly
 - Examples...
 - Cracked Packages
 - V_{DD} to V_{SS} Electrical Shorts

D— Test

- Test
 - Examples...
 - Test Damage
 - Test Escape / Test Coverage

TAB 4— Electrical Fault Isolation

- Electrical Fault Isolation (Introduction)
 - Semiconductor Parametrics
 - Test Binning
 - I_{DD} / I_{DDQ}
 - Shmoo Plots
 - Curve Tracer Testing

TAB 5— Physical Fault Localization

Physical Fault Localization (Introduction)

Optical Microscopy

Reprint: published in SEMITechnology Symposium 1999 Chiba, Japan.

"Fast and Non-destructive Detection of Crystal Defects in Wafer by Imaging of Local Stress"

Mechanical Probing

Liquid Crystal Hot Spot Detection

Cathodic Copper Deposition

Emission Microscopy

Scanning Electron Microscopy

 Secondary/Backscatter Imaging

Passive Voltage Contrast (low energy)

High Energy Passive Voltage Contrast

 Example...

 Via Continuity

Electron Beam Induced Current (EBIC)

Absorbed Current

Resistive Contrast Imaging (RCI)

Specialized Techniques

 Dynamic Voltage Contrast

 Charge Induced Voltage Alteration (CIVA)

 Optical Beam Induced Current (OBIC)

 Light Induced Voltage Alteration (LIVA)

TAB 6— Sample Preparation Techniques

Cross Sectioning

 Cleaving

 Non-encapsulated Cross Sectioning

Product Sheet: from Accelerated Analysis

 (PF101) Cross Section Fixture

 Focused Ion Beam (FIB)

 TEM

Reprint: from Advanced Materials Engineering Research Corporation (AMER)

 "Applications of the Transmission Electron Microscope in Semiconductor Materials"

Deprocessing

 Mechanical (Parallel) Polish

Product Sheet: from Accelerated Analysis

 (PF201) Parallel Polish Fixture

 Chemical Wet Etch

 Deprocessing Chemicals (Table)

 Wet Etch Passivation Removal

 Plasma Dry Etch / Reactive Ion Etching (RIE)

 Focused Ion Beam (FIB)

Laser Material Removal
Backside Polish Considerations

TAB 7— Analytical Techniques

Analytical Techniques (Introduction)

Charts & Tables: from Charles Evans & Associates®

Table—Analytical Techniques

Chart—Description of Techniques

"Bubble" Diagram—Analytical Resolution versus Sensitivity

Chart—Analytical Techniques

Chart—Semiconductor Measurements & Process Controls

- 7.1 Energy Dispersive Spectroscopy (EDS)
- 7.2 Wavelength Dispersive Spectroscopy (WDS)
- 7.3 Auger Electron Spectroscopy (AES)
- 7.4 Secondary Ion Mass Spectrometry (SIMS)
- 7.5 Fourier Transfer Infrared Spectrometry (FTIR)
- 7.6 X-ray Photoelectron Spectroscopy (XPS)
- 7.7 X-ray Fluorescence (XRF)
- 7.8 Rutherford Backscattering Spectroscopy (RBS)
- 7.9 Scanning Tunneling Microscopy (STM)
- 7.10 Scanning Probe Microscopy (SPM)

Reprints: from Digital Instruments, Inc. (DI)

"IC Failure Analysis and Defect Inspection *With Scanning Probe Microscopy*"

"Scanning Thermal Microscopy With *Nanoscope® Scanning Probe Microscopes*"

"The Dimension™ Metrology AFM Head *For Critical Dimension Measurements*"

TAB 8— Test Structures

Test Structures (An Overview)

TAB 9— Equipment

Failure Analysis Equipment

TAB 10— Appendices

A— Charts & Tables

Symbols & Abbreviations

Periodic Table

B— Acronyms & Abbreviations

Acronyms & Abbreviations

C— Glossary

Glossary

D— Resources

Recommended Reference Text

Resources