TJ GREEN ASSOCIATES, LLC

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Video Training Library On Line Course Outline

Hybrid Materials Processes and Defect Recognition (Modules #1-10)

Course Description

Many companies waste countless man-hours and resources resolving problems on the manufacturing floor. Much of this waste is due to inadequate training of the responsible engineers and technicians working on the factory floor. This course is designed to teach the fundamental materials and processes used in microelectronics manufacturing and develop in the student an understanding of the relevant visual inspection criteria. "Knowing what to do" is the first step towards lower costs, improved quality, and faster throughput. This VTL series is a tailored, condensed version of the four day Process Certification course. It's a high quality, professional video reproduction of the original course recently taught at a large aerospace company located in Denver Colorado.

Learning Outcomes

- Advance your understanding of the basic materials and processing steps used in the assembly of Hybrids, Microcircuits and RF/MMIC Modules.
- Be able to explain to others visual defects that result from the basic manufacturing processes e.g., wire bond, component attach, thick and thin film processing, etc.
- Learn how to avoid critical quality and reliability problems that cause field failures.

Course Outline

Module # 1 (1 hr 15 min)

Course Overview
Introduction to Hybrid Manufacturing Processes
    Terminology and product definitions
    Hybrids , multi chip modules MCMs, RF microwave modules etc.
Manufacturing Assembly Process Overview
    Basic manufacturing process flows
Visual Inspection and Mil Spec Source Requirements
    MIL-PRF-38534 and MIL-STD-883

Module # 2 (1 hr 28 min)

Mil Spec Source Requirements (Cont.)
Visual Inspection Overview
    Incoming, Pre Cap and external visual inspection criteria
Silicon Semiconductor Processing Overview

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GaAs (gallium arsenide) MMIC (monolithic microwave IC) Wafer Fab Overview
- Wafer saw and probing defects
- Clean room requirements and industry protocols

Typical Wafer Fab Defects
Incoming high power wafer/chip inspection

Module # 3 (1 hr 26 min)

High Power Die Inspect, Airbridge Defects
Foreign Material Identification and Control
- What is acceptable?

Thick Film Ceramic Processes
Substrate Fabrication and Materials Overview
- Screen printing machine variables and controls
- The drying and firing process
- Ceramic substrate quality issues

Laser trimming
- Defects resulting from laser trim processes

Module # 4 (1 hrs 26 min)

Photo Defined Thick Film Processes
Low Temperature Cofired Ceramics (LTCC)
Thin Film Processes
Sputtering vs. Vapor Deposition
- Photolithography, coat, and etch

Plating Operations
- Electrolytic vs. electroless plating
- Wirebond issues due to poor plating, problems bonding to duroid

Thin Film Process Video (10 minutes)
Substrate Evaluation Requirements

Processing Fundamentals for Epoxy Attach
- Test Method 5011 explained

Module # 5 (1 hr 11 min)

Short Review of Modules 1-4

Epoxy Die and Substrate Processes
- Material properties of typical polymers used in assembly
- Critical processing parameters

Issues with Auto Dispense and Component Placement
Die and Substrate Defects
Auto Die Placement Video (10 minutes)

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Epoxy Fillet Visual Criteria 50% rule
Things to Look for After Die Attach
Epoxy Resin Bleed

Module # 6 (1 hr 28 min)

Discrete Component Epoxy Attach Processes
- Multi layer chip caps (MLCs), resistors, and parallel plate capacitors

Epoxy Shorts, Excess Epoxy
Passive Element Evaluation Requirements
Silver Dendrites
Eutectic Solder Attach of GaAs Chips
- Auto eutectic chip attach, scrub process
- Vacuum soldering (vacuum solder video)

Test to determine die bond integrity (X-ray, acoustic image, die shear etc.)
Thermal design considerations, trade offs and CTE issues
Review of thermal analysis spreadsheet

Module # 7 (1 hr 28 min)

Excel Thermal Spreadsheet Review (cont.)
Silver Dendrite Video
FEA (finite element analysis) Modeling
- Die/substrate cracking due to mis matched CTE

Cleaning Processes Prior to Wirebond
- Plasma, ultrasonic and wet chemicals

Wirebonding Process Overview
- Thermosonic gold ball bonding
- Gold ball bonding video (10 minutes)

Wire Bond Visual Inspection Criteria

Module # 8 (1 hr 26 min)

Gold Ball Bonding (Cont.)
- Review of visual defects, ball and stitch
- Bond failures due to surface contamination
- Security bonds
- Reliability problems e.g. purple plague, cratering, contamination etc.

Ultrasonic Wedge Bonding
- Wedge bond defects; heel cracks, excess tails etc.

Ribbon Bonding

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Module # 9 (1 hr 10 min)

Short Review of Modules 6-8

Heavy Gage Wire Bonding

Factor That Affect the Wirebond Process

- Wirebond cause and effect diagram

Material Properties of Bonding Wire

Wire Bonding Tools

Wire Testing

- Wire pull testing and failure modes
- Ball shear testing

What is Hermeticity and Why is it Important?

Hermetic Packaging Process Overview

- Seam sealing, solder seal
- Seal process cause and effect diagram

Module # 10 (1 hr 44 min)

Laser Welding Hermetic Packages

External Visual Inspection

- Cracked glass seals, defective welds etc.

Hermeticity Testing per Mil-Std-883 TM 1014 (Seal)

- Gross and fine leak methods
- Review of Howl and Mann equation and excel spreadsheet
- Optical Leak Testing (OLT)
- CHLD (Cumulative Helium Leak Detection)
- Radioisotope KR-85 method

Residual Gas Analysis (RGA) per TM 1018

- Moisture inside hermetic packages and importance of pre seal vacuum bakes
- Hydrogen poisoning
- Getters

Course Summary and Review