Overview of Japanese Microelectronics Technology

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1999.12.15.

IMAPS Japan

1st Korea-Japan Joint Seminar

Overview of Japanese Microelectronics Technology

S.Denda
IMAPS Japan

1999.12.15 in Seoul

Microelectronic Packaging R & D Activity

- JIEP (Japan Institute of Electronics Packaging)
- IMAPS Japan (Committee)
- NEDO (New Energy and Industrial Tech. Develop. Organization)
  High Density Elrctronic System Integration Project
  (3D LSI, Optoelectronics, Wiring design)
- EIAJ (Electronic Industry Association of Japan)
  Research Committee
- Tokyo University Packaging Laboratory

- International Symposium (IEMT/IMC)
- Domestic Conferences
- Technical Meetings, Seminars and Workshops

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Technology Roadmap

- JIEP: Packaging Technology in 2010

1.Relation to Electronics Industry
2.Packaging materials
3.Environmental Friendly Technology
4.Circuit Design
5.EMC
6.Circuit Board Manufacturing
7.Equipment and Automation
8.Reliability
9.Electronic Devices ⇐
10.Components Mounting
11.Inspection
12.Optoelectronics
13.21st Century Packaging

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Application of Advanced Packaging

- Notebook PC (Note PC)
- Video Cameras
- Mobile Machine, PDA
- Poratable Telephone
- LCD Display
- Game Player
- Electronic Cards
- Car Electronics

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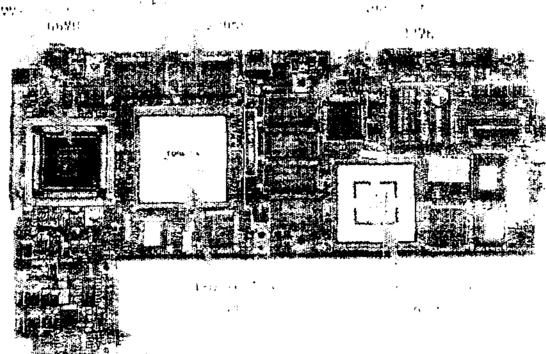
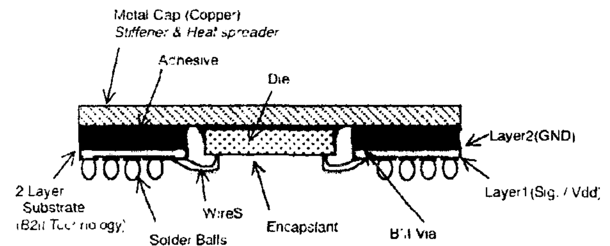
Libretto 1000 Substrate



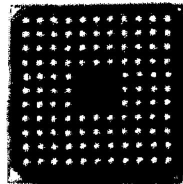
Semiconductor Packages

- Area Array Packages
  - BGAs
    PBGA, TBGA
    MBGA, EBGA
    FBGA(<0.8mmP)
    (=CSP)
  - CSPs
    TCSP, MCSP
    CCSP, μBGA
  - Wafer Level CSP ⇦

- Flip Chips
  SBB
  WL Flip Chip
- Stacked Package
- TAB,TCP
- Outer lead QFP
  0.5mm Pitch
  0.4mm Pitch



Toshiba EBGA



112 pin CSP 10x10mm (Hitachi)

Principal Area Array Structure -1

- Over 50 Area Arrays Announced
- Most of Venders have
  oPBGA, FBGA, Tape CSP

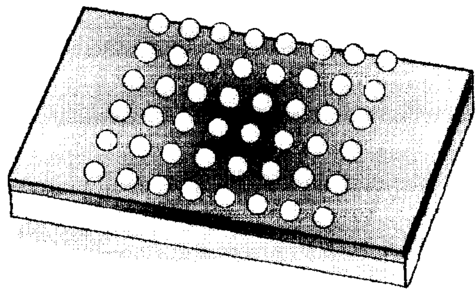
- Toshiba
  o, EBGA, 2 Metal BGA,QFN,PTP
- Hitachi
  o μBGA, Fan in CSP, FBGA ⇦
- IBM
  oOMB-FCA
- NEC
  oD2BGA,FPBGA, MCM,
- Fujitsu
  oSuper CSP,SON,MCM
- Matsushita
  oC-CSP,LGA

Principal Area Array Structure -2

- Sharp
  oStacked CSP, LCD Driver
- Mitsubishi
  oMold CSP
- TI
  oMicrostar
- Sony
- Oki
  oWLP CSP
- Epson
- Rohm
- Citizen
- Shinko
  oSuper-CSP, μBGA, MOST
- Ibiden

WLP-Wafer Level Packaging

- Packaging process is completed at the end of the wafer process
- Ultimate low-cost, minimum size package
- Acceptable reliability by resin coating
- Matches to low pin-count (50-100)devices
- Fan-in redistributed bump layout
- Redistributed flip chip structure is Included
- Fujitsu-Shinko, Oki-Casio, Ibiden-Atomnics, Epson,Toshiba,Formfactor-Shinko



Super CSP (Wafer Level Package)

Chip Stacking Structure

- 3-Dimensional Chip Integration
- Sharp : Stacked CSP , WB+FC
  DRAM+SRAM,SRAM+Flush,1.4mmH
- NEC : Memory Chip Stacking
  Au Bump FCs on Glass-Epoxy
- Toshiba : SLCC, Paper Thin Package
  Chip 50 μ
- Fijitsu : SOC Module

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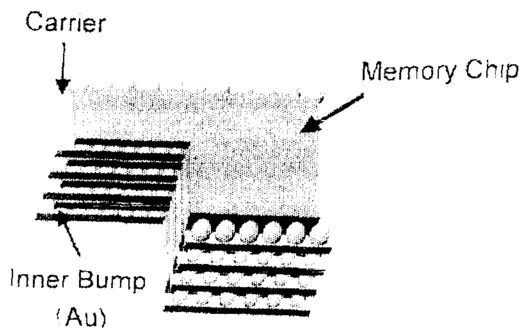

Flip Chip Memory Stacking

Printed Circuit Board Process Technology

- Laser Via and Photovia Technology (80 μ)
- Fine Pitch Wiring (25 μ ,IBM)
- Via Filling by Copper
- Low K Material Development
- Super Soft Flexible Tape for LCD Driver
- Surface Roughning Process for Substrate and Cu

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Built-up Substrates

- Multi Layer PCB+Built-up Layers
- Typical Built-up 1-4 Layers
  (Via 100 μ ,L/S 50 μ)
- Surface Laminar Circuit, IBM
- B2IT(Toshiba), Thick Film Paste Bump on Cu, All Layers Built-up
- ALIVH(Any Layer Interstitial Via Hole) (Matsushita),Laser Drilling, Paste Filling Big Market Share for Telephone
- IBSS(Ibiden) Via diameter 80 μ

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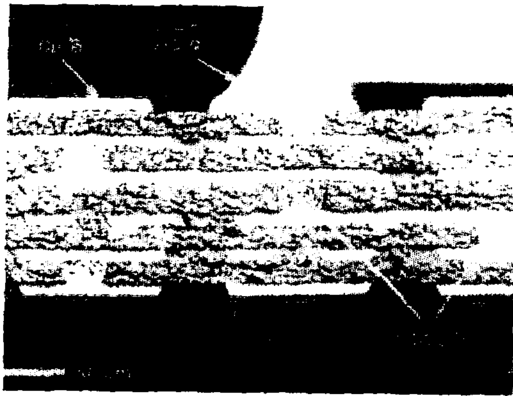
Built-up Substrate, Ibiden



ALIVH Substrate (Matsushita)

Anisotropic Conductive Material and Underfill

- Vertiacl Directiobn(R=0)
- Horizontal Direction (R=∞)
- Ni, Plastic, Metal balls, Cu Pillar
- Film (ACF), Paste (ACP),
- Toshiba Chemical, Hitachi Chemical, Sony Chemical, Nitto,
- Underfill Material ,Liquid Epoxy
- Capillary Flow Characteristics

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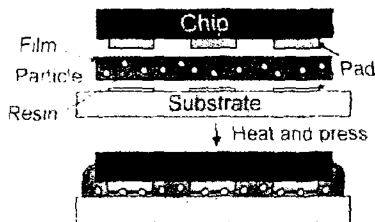

Anisotropic Conductive Paste

MCM—Multi Chip Module

- Limitted Mother Board Area
- Peripheral Pad Flip Chip with Underfill
- CPU and Memory Chips on MCM for PC
- Using Built-up,Fine Pitch Substrate
- Having Area Array Solder Bumps

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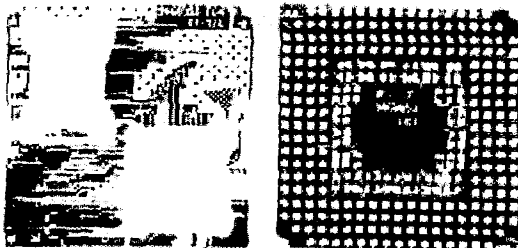

Multi Chip Module (NEC)

Board Level Reliability

- Good Reliability for Package alone
- Secondary Reliability (Board Level Reliability), Themal Cycling (-40~125°C), more than 1000 Cycles Necessary
- Result of thermal expansion difference among chip,interposer and board
- Simulation Analysis of Internal Stress in Bumps
- Utilize Finite Element Method (FEM) and Software

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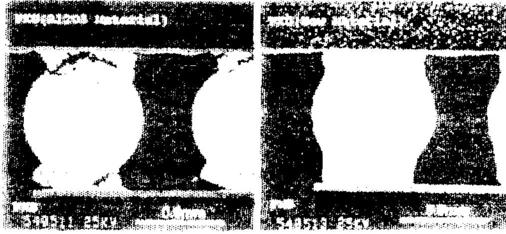

[illegible] 400 Cycle

Board Level Reliability

Lead Free Solder

- Sn-Ag-X and Sn-Zn-X Systems
- Application to Volume Production Started
- Infrasturcture is in Progress (Furnace, Flux, Components, Chemicals)
- Matsushita : Sn-Ag-Bi (MD Player Production)
- Sony:Sn-Bi-Ag-Cu-Ge
- Toshiba:91Sn-9Zn
- NEC:Sn-Ag-Cu
- Indium Solder Development
- Organic Conductive Adhesives
- Extensive Research for Pb Free Solder

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Bumping Works

- Solder Ball Mounting
- Solder Paste Printing
- Solder Paste Transferring
- Metal Ball Mounring
- Electroplating of UBM,Au,Cu and Solder
- Electroless Plating of Ni-Au on Al Pad

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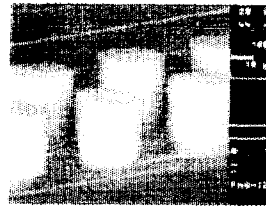

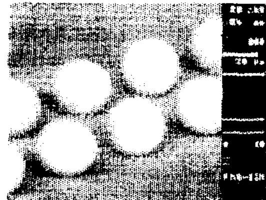

Solder Plating and Reflow (50 μ Piitch)

New Oragnic Materials

- High Tg Material Development
- BT Resin,Tg 170℃
- 293℃ MQ Polymer,Hitachi
- Photosensitive Composit Material, IPN (Inter Penetrating Network, Ibiden) Tg200℃
- Photosensitive Polyimid,Tg 230℃, Fujitsu
- DSOL-Deposited Substrate on Laminate Tg230℃, NEC
- Photosensitive Polyimide
- Liquid Crystal Polymer Film Development
- Undefill Capillary Flow, Compression Flow
- Liquid Encapsulant

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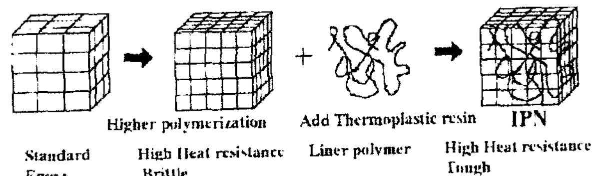

Interpenetrating Network Structure (Ibiden)

Environment Friendly Technology

- Reducing Environmental Load from Electronic Products
- Life Cycle Assessment ,LCA
- CFC Usage Stopped
- New Solvent and Water System Develop
- Halogen Free Body, PC Board and Potting Resin Materials
- Volatile Organic Compounds (VOC) in Flux and Solvent
- Recycling of Printed Circuit Board

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EMI-Electromagnetic Interfarance

- CPU Operation Frequeny Increase(500MHz)
- Power Line Switching Noise
- Electromagnetic Field Analysis using Software
- Shielding by Multilayer Substrate
- Grounding Pattern Design
- Electromagnetic Wave Dark Room (Site) for Checking Product EMI
- EMI of Semiconductor Packages

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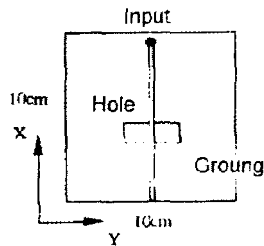

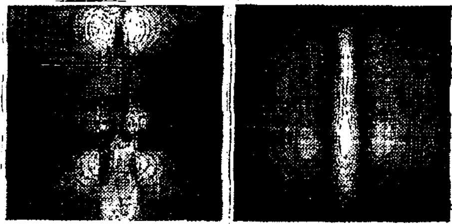

PC Board and EM Field

Advanced Assembliy Equipments

- CSP, Flip Chip Bonder
  Higher Placement Accuracy(~80 μ) than Conventional Mounter
- Dispencing Liquid resin and Underfill
- N2 Furnace for Pb Free Solder
- Water washing system
- Wafer level burn-in
- Area Array Repair System
- X-Ray Inspection
- Sonic Wave Inspection

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