3-D Micro Assembly of Molded Interconnect Devices (3-D MID)
Häcker Automation GmbH

- Machine manufacturing company
- Based in Germany
- Operating since 1995
- 48 Employees
- Services
  - Process Development
  - Technology Consulting
  - Prototyping/Testing
  - Machine/Device Manufacturing
  - Application Centre
  - Turnkey handover, Training
  - Maintenance

Core Areas of Competence
- 3-D Micro Assembly
- Nano + Micro Dispensing
Highly modular design concept

- Base machine “VICO Base 520”
- Integrated platform for
  - Micro Assembly
  - Nano + Micro Dispensing
  - Optical 3-D Inspection
- Control Software
  - Win32-Application with GUI
  - Tested and proven
- Characteristics
  - Positioning accuracy: ±10 µm @ 3 sigma
  - Dispensing dot: ±0,1 nl @ 6 sigma
  - Setup time: < 5 min
  - Machine capability: $c_{mk} > 2,0$
  - Availability: > 97%
Extension Devices
- “VICO Base 520” can host extension devices
- Covering various application fields
- 66 (at the moment)
  - freely combinable
  - permanently evaluated and improved
  - device pool steadily enhanced
- Communication between base machine and extension devices by CAN industrial bus system
  - short set-up times
  - easy (re-)configuration of machine/devices
  - real-time communication
Problem

2-D Substrates
- Placing/Dispensing on plane surfaces
- i.e. PCB

2-D Recognition
- (X,Y,Θ) Recognition/Inspection of plane surfaces

2-D Adjustment
- (X,Y) Moving of substrate/tool to match exact position for placing/dispensing process
Problem

3-D Micro Assembly of Molded Interconnect Devices (3-D MID)

3-D Substrates
- Placing/Dispensing on uneven surfaces
- i.e. 3-D MID

3-D Recognition
- \((X,Y,Z,\Theta)\) Recognition/Inspection of uneven surfaces/object positions

3-D Adjustment
- \((X,Y,Z,\Theta_{X,Y,Z})\) Moving of substrate/tool to match exact position for placing/dispensing process
3-D Recognition

- 3-D Vision System (1)
  - 3-D-ready recognition system
  - Standard equipment of “VICO Base 520”
  - Design
    - Stereoscopic camera system
    - Focusing object from different points of view
  - Control software calculates from captured image data
    - (X,Y,Z) position of object
    - object’s surface condition
### 3-D Recognition

- **3-D Vision System (2)**
  - **Characteristics**
    - Search area: ca. (2.5 x 2.5) mm$^2$
    - Accuracy: ±2 μm
  - **Benefits**
    - Automated recognition of substrates/parts/components
    - Automated position correction of tool head in order to compensate tolerances (X,Y,Z) up to 250 μm (i.e. caused by MID manufacturing process)
    - Automated Optical Inspection (AOI) of finished assemblies
3-D Adjustment

- 3-D Substrate Carrier (1)
  - Extension device for “VICO Base 520”
  - Adjustment of substrate to favorable placing/dispensing position by
    - rotating (>360°)
    - tilting (>90°)
  - Tool head can reach every point within complete half-space above substrate
  - Adapter to enable mounting of substrates of different designs
3-D Adjustment

- 3-D Substrate Carrier (2)
  - Aims: full 3-D adjustment control with max. stiffness + zero backlash
  - 1st Iteration step
    → max. stiffness, high friction movement
  - 2nd Iteration step
    → max. stiffness, improvement in backlash, but issues with long-term stability
  - 3rd Iteration step
    → max. stiffness, full 3-D adjustment control, zero backlash, long-term stable
Supplement Devices

- 3-D Adjustment (3-D Substrate Carrier)
- 3-D Recognition (3-D Vision System)
- Tool Heads
- Dispensing Devices
- Wafer Handling
- Part Handling
- Substrate Transport
Tool Heads

- Pick-and-Place tools
  - Different techniques
    - vacuum-based
    - gripping mechanism
  - Tools of standard and process-dependable design

- Tool Changing Unit
  - fast tool-changing inside working area of the machine
  - easily scalable

Special purpose heads

- UV-curing head
- Laser Soldering head
- Heating head
Dispensing Options

- Dispensing Heads
  - Feedback loop-controlled dispensing

- Direct Dispensing Station
  - Applying structures on substrates (pin transfer, stamping)
  - Areal application of fluids on parts

- Assistance devices
  - Needle Calibration Unit
  - Needle Cleaning Unit
  - High-Precision Balance
Wafer Handling

- Die Eject Unit
- Wafer Adapter
- Wafer Expander
- Wafer Changing Unit
Part Handling

- Flip Station
  - Flip Chip processing
- Waffle Pack
- Gel-Pak
- Tape Feeder
  - Tape & Reel
  - Belts
- Stick Feeder
Transport Systems

- Conveyor
  - SMEMA-compatible
  - Siemens-compatible
- Vibratory Conveyor
- Bowl Feeder/Spiral Conveyor
- Shuttle Axis
- Auer Boat
  - Loader
  - Unloader

3-D Micro Assembly of Molded Interconnect Devices (3-D MID)
Summary

- Stable and reliable solution for real 3-D Micro Assembly
- Proven in batch-production since 2001
- VICO 520 + Extension devices
  - getting utmost precision (±10 µm @ 3sigma) and staying very flexible
  - Easy
    - scalable
    - reconfigurable
    - combinable
- Automated inspection as part of assembly process (No need of separate AOI machine in production line!)
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- hybridica | Munich, Germany | November 9th – 12th, 2010
  Joint exhibition booth of 3-D MID e.V.
  → Demonstration of 3-D Substrate Carrier + 3-D Vision System