Simulation of the Dynamic Behaviour of a Droplet on a Structured Surface using the Non-conservative Level Set Method

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05.11.2008
Outline

- Motivation
- State of the art
- FluidAssem technology
- Summary
Motivation

Miniaturization and higher integration

Limits for conventional methods in microassembly

Novel fluidic-based selfassembly technology

Quelle: www.heise.de
Source: www.motioncontrol.no
Chip alignment

microchip

Source: FhG/IPA
Outline

➢ Motivation

➢ State of the art

➢ FluidAssem technology

➢ Summary
State of the art in chip assembly

- Chip separation
- Positioning
- Alignment
- Fixing and contacting
- Housing

- Saw/Laser
- Pick and Place
- Heat/UV curing, wire bonding, flip chip
- Sealing/underfilling

Source: www.motioncontrol.no

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Chip assembly with FluidAssem

- Chip separation
- Positioning
- Alignment
- Fixing and contacting
- Housing

new

FluidAssem
New method for assembly (1)

- microchip
- contact bumps
- catching droplet
- contact droplets
- hydrophobic areas (orange)
- hydrophilic areas (white)
- metallization

Source: IFF/MST
New method for assembly (2)

Source: IFF/MST
Positioning of droplet

Initial displacement

Time for alignment: 
~ 12 ms

Source: IFF/MST
Dimension of hydrophobic ring

Initial displacement

~70µm

Initial displacement from target position [µm]

Width of hydrophobic ring [µm]

Source: IFF/MST

Source: IFF/MST

Source: IFF/MST

Source: IFF/MST
Positioning the droplet

Source: FhG/IPA
Time for chip alignment

- Partition of alignment process

Chip-alignment = horizontal + vertical

\[ t_{\text{total}} < t_{\text{horizontal}} + t_{\text{vertical}} \]
Horizontal chip alignment

Time for horizontal alignment: \(~ 0.2 \text{ ms}\)

Size of microchip
- 500 \(\mu\text{m}\)
- 300 \(\mu\text{m}\)
- 100 \(\mu\text{m}\)

Source: IFF/MST
Vertical chip alignment

Time for vertical alignment: ~ 0.7 ms

Source: IFF/MST
Total time for chip alignment

- **Horizontal** ~ 0.2 ms
- **Vertical** ~ 0.7 ms

**Total time < 1 ms**
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- A novel assembly method was presented
- Feasibility studies were done
  - Time for droplet positioning ~ 12 ms
  - Time for chip alignment ~ 1 ms
Thank you for your attention!

Acknowledgement: BMBF, VDI/VDE-IT