**COMSOL Conference
Hannover 2008**

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

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Produktionstechnik und
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Cooperation

www.ipa.fhg.de

Source: FhG, IPA

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www.iff.uni-stuttgart.de

Source: Uni Stuttgart, IFF

Universität Stuttgart

iFF mst

Institut für Industrielle Fertigung und Fabrikbetrieb Lehrstuhl Mikrosystemtechnik

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Slide 2

Outline

➤ **Motivation**

➤ **State of the art**

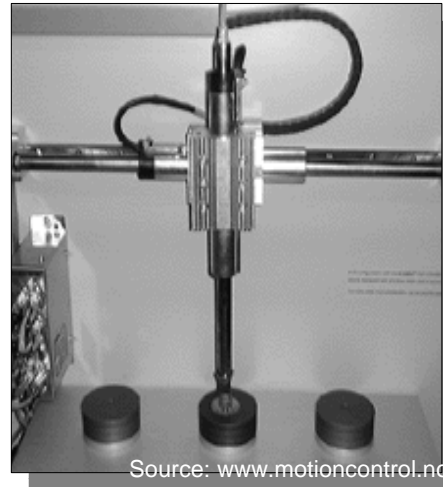➤ **FluidAssem technology**

➤ **Summary**

Motivation

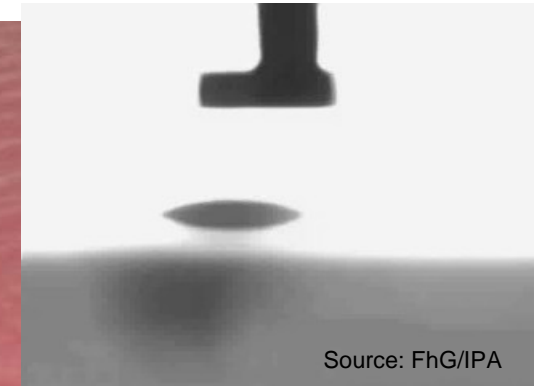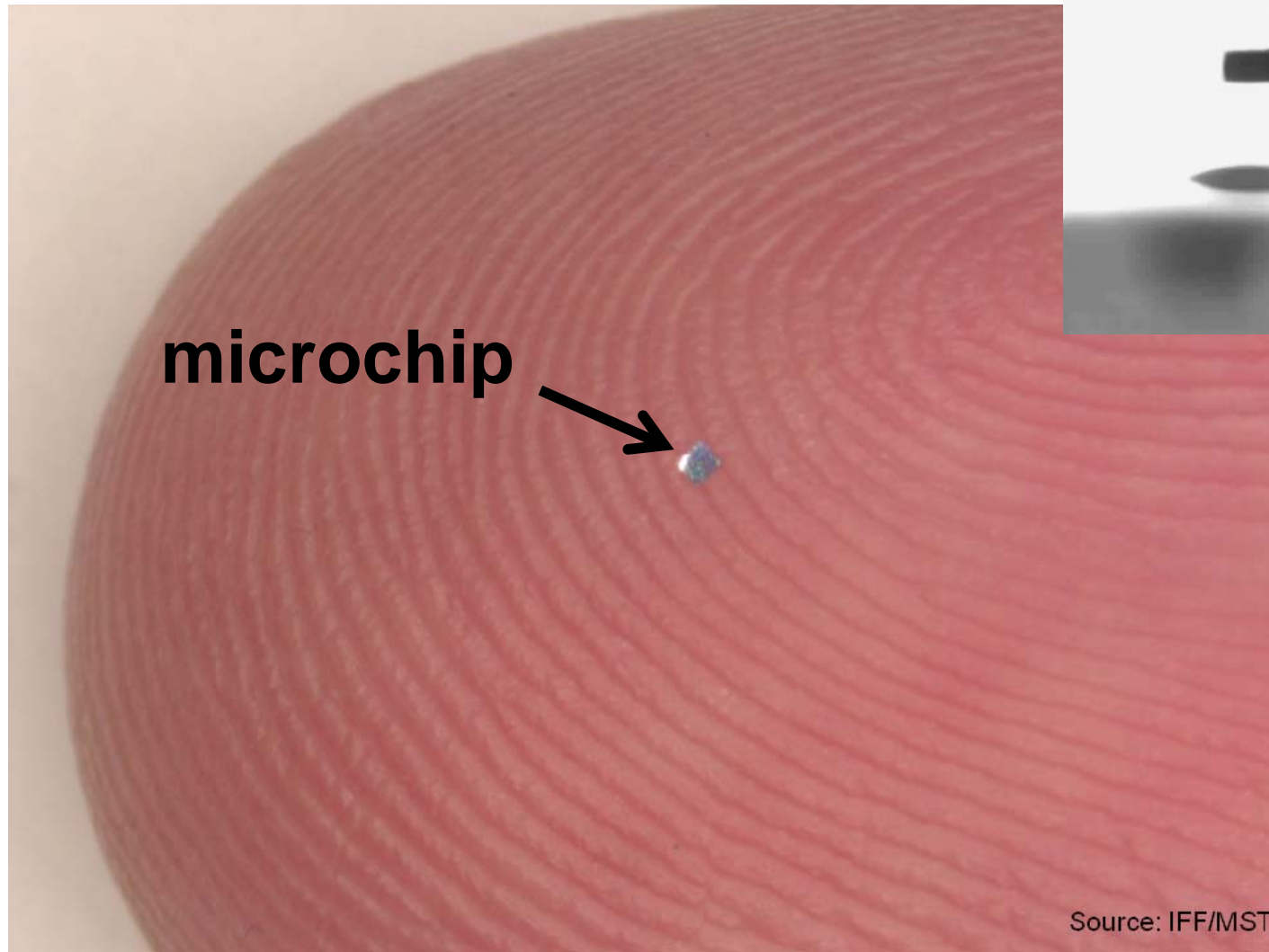**Miniaturization and higher integration** → **Limits for conventional methods in microassembly** → **Novel fluidic-based selfassembly technology**

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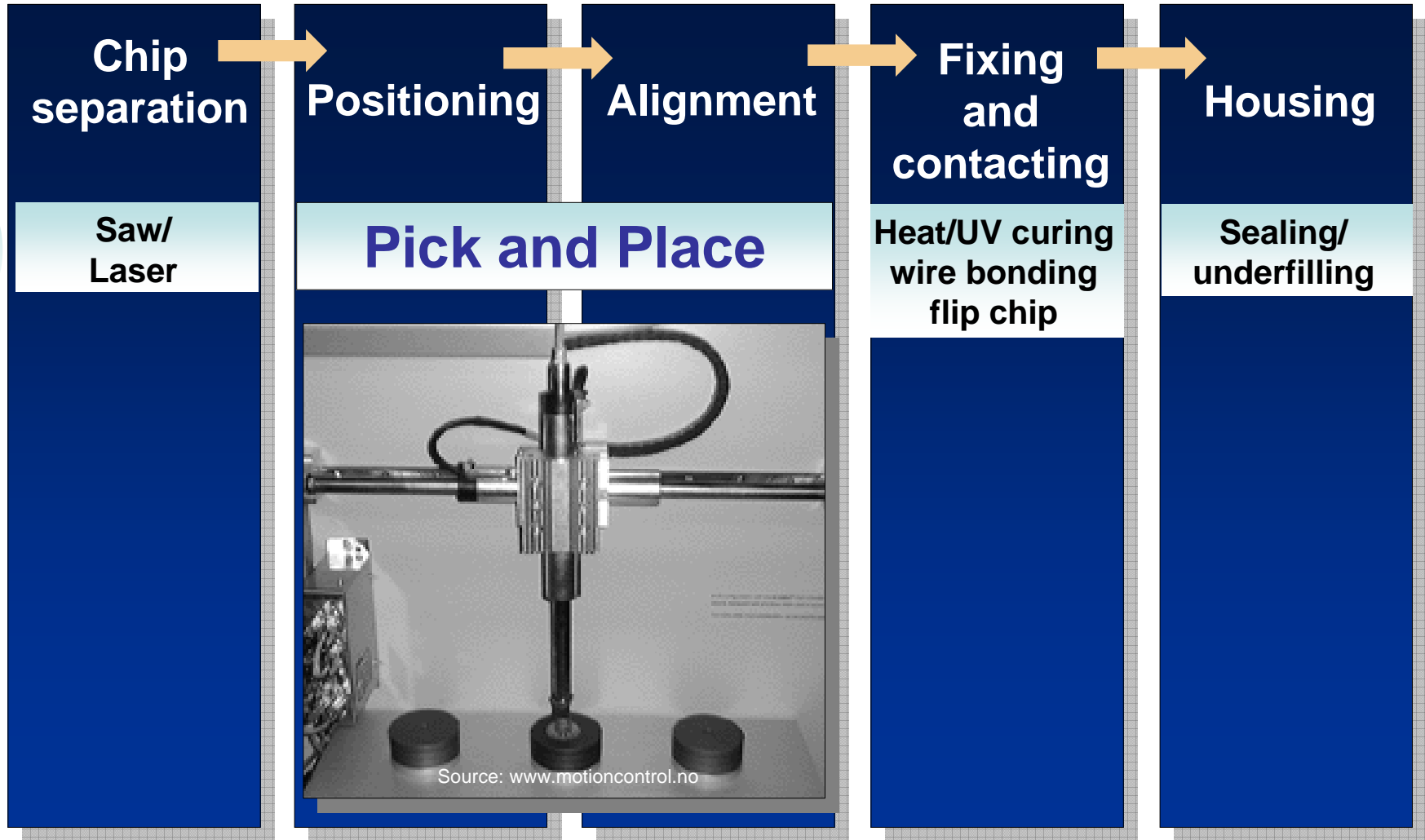
Source: www.motioncontrol.no

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Chip alignment

microchip

Source: FhG/IPA

Source: IFF/MST

Outline

➢ **Motivation**

➢ **State of the art**

➢ **FluidAssem technology**

➢ **Summary**

State of the art in chip assembly

State of the art

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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Outline

> ➢ **Motivation**

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> ➢ **FluidAssem technology**

> ➢ **Summary**

Chip assembly with FluidAssem

new

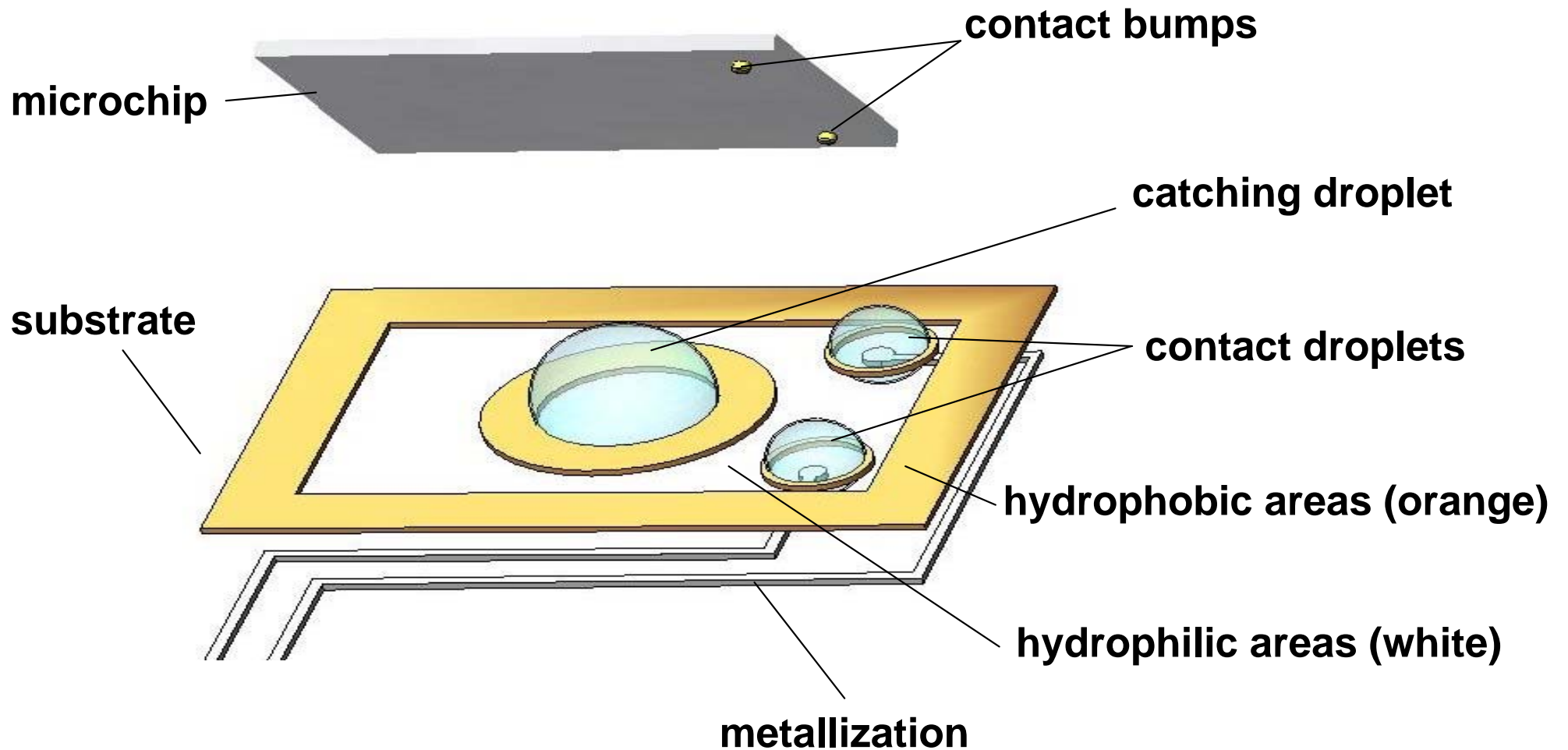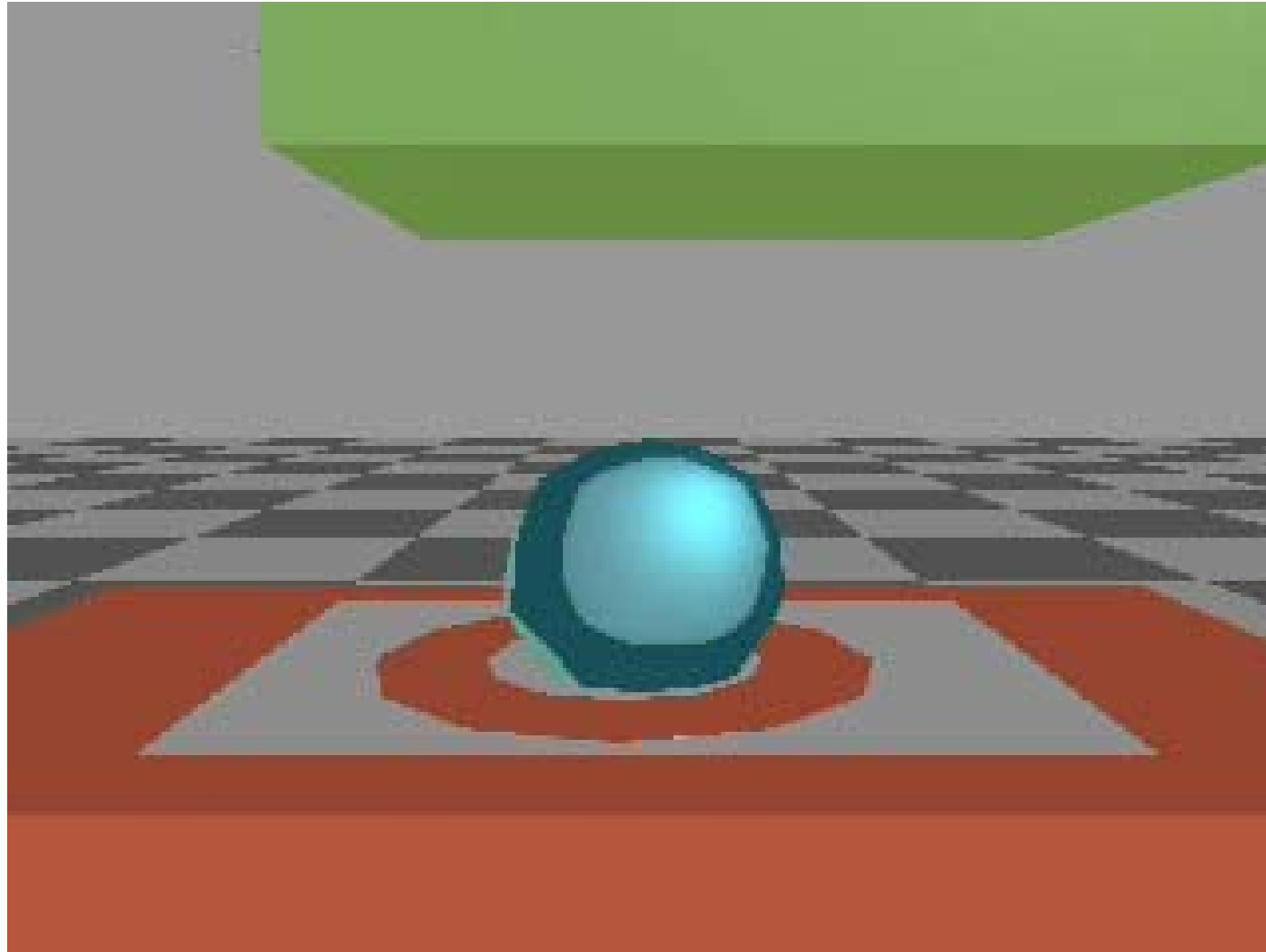| Chip separation	Positioning	Alignment	Fixing and contacting	Housing

FluidAssem
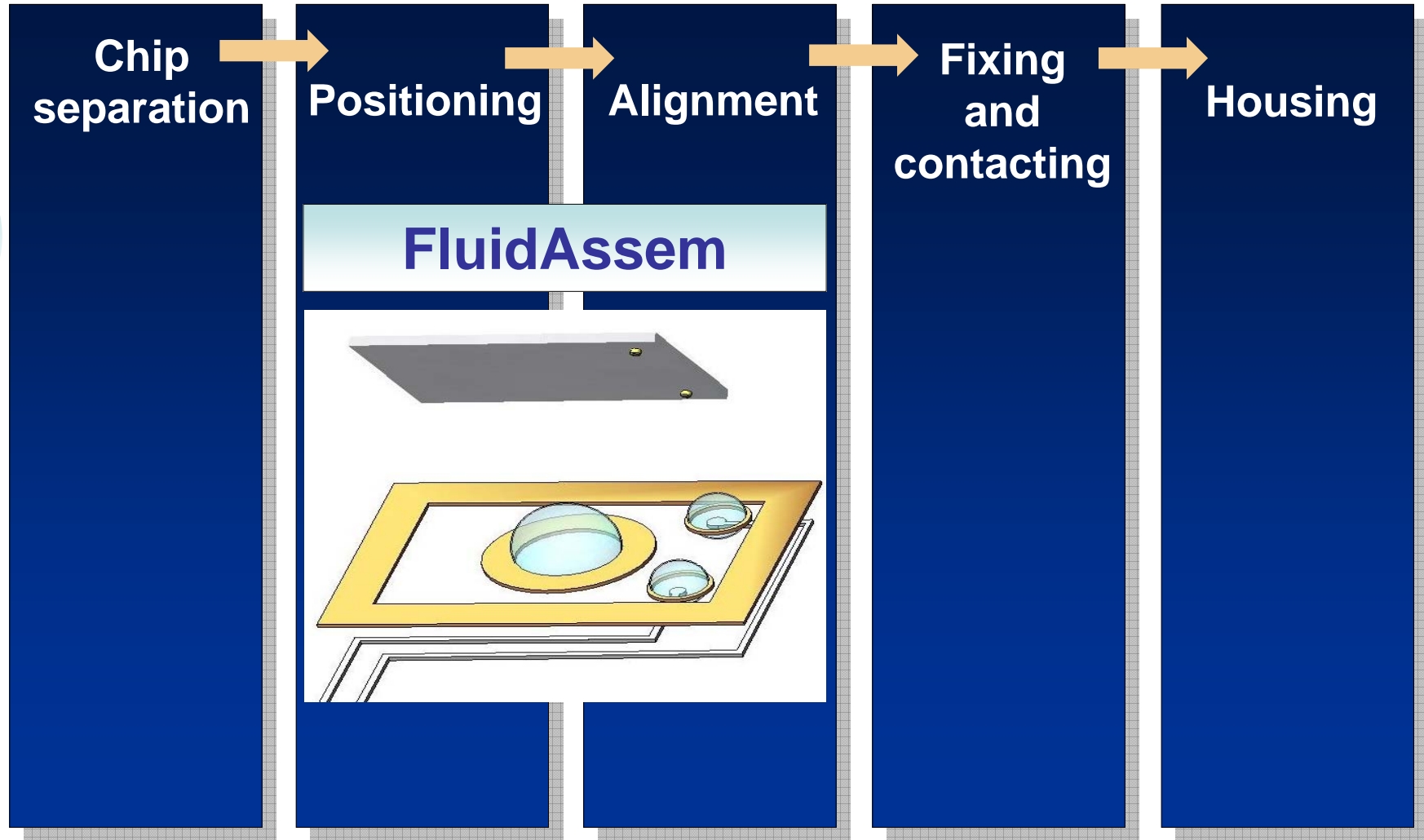
New method for assembly (1)
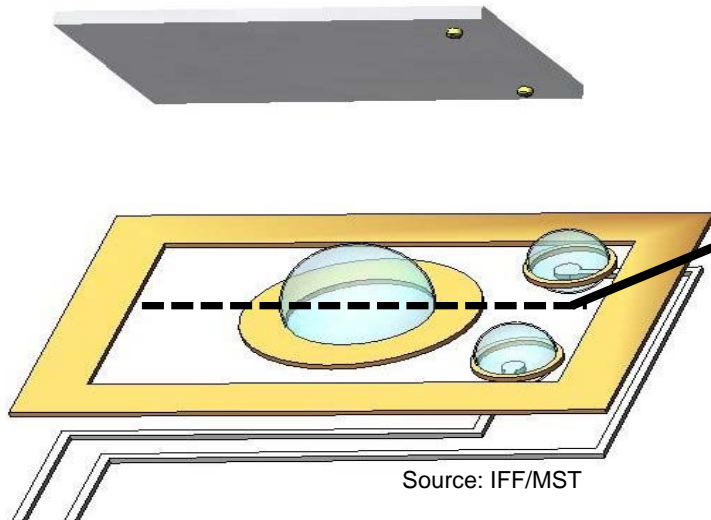

Source: IFF/MST

New method for assembly (2)

Source: IFF/MST

Positioning of droplet

Initial displacement
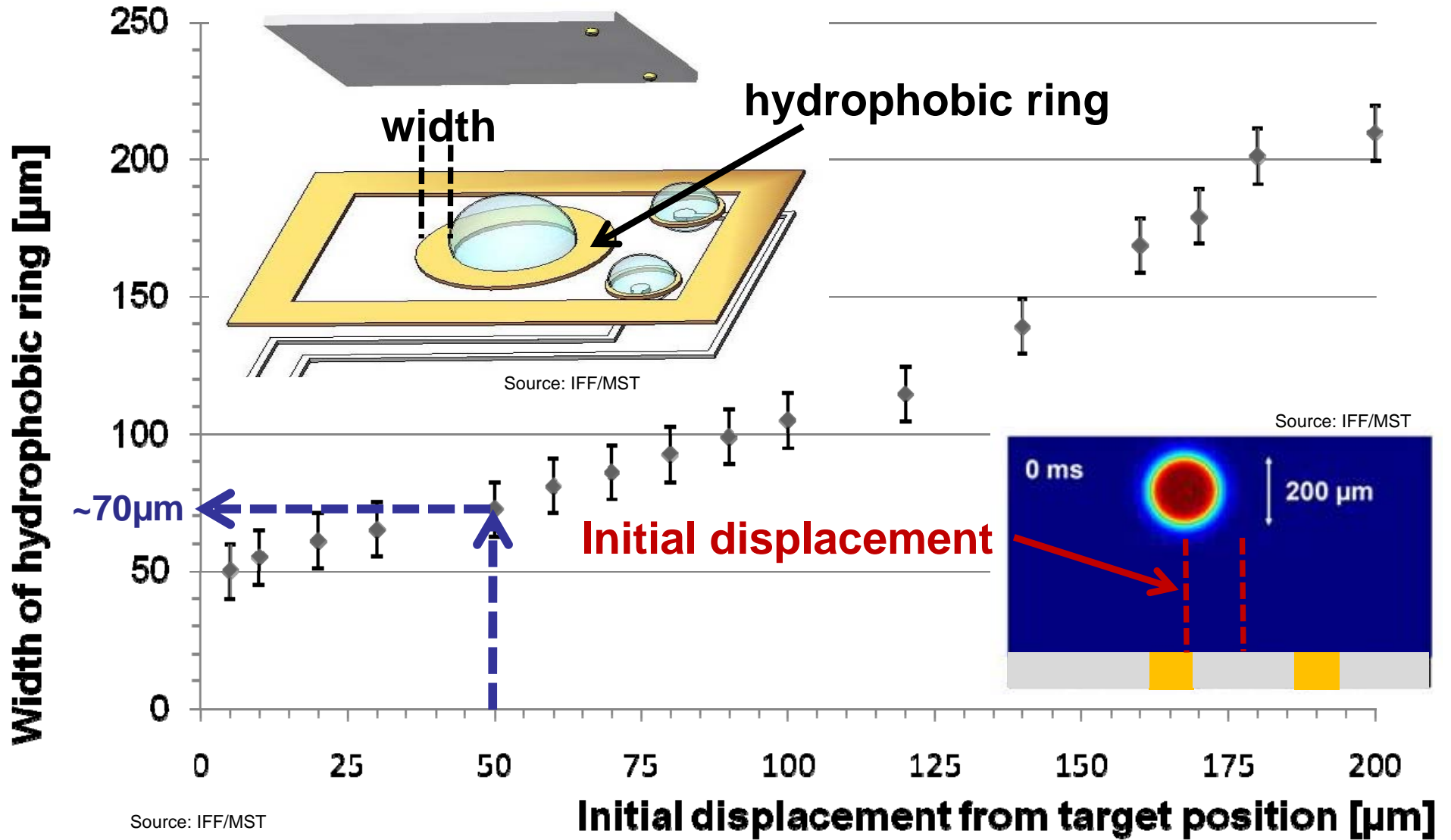
Time for alignment:
~ 12 ms

Source: IFF/MST

Source: IFF/MST

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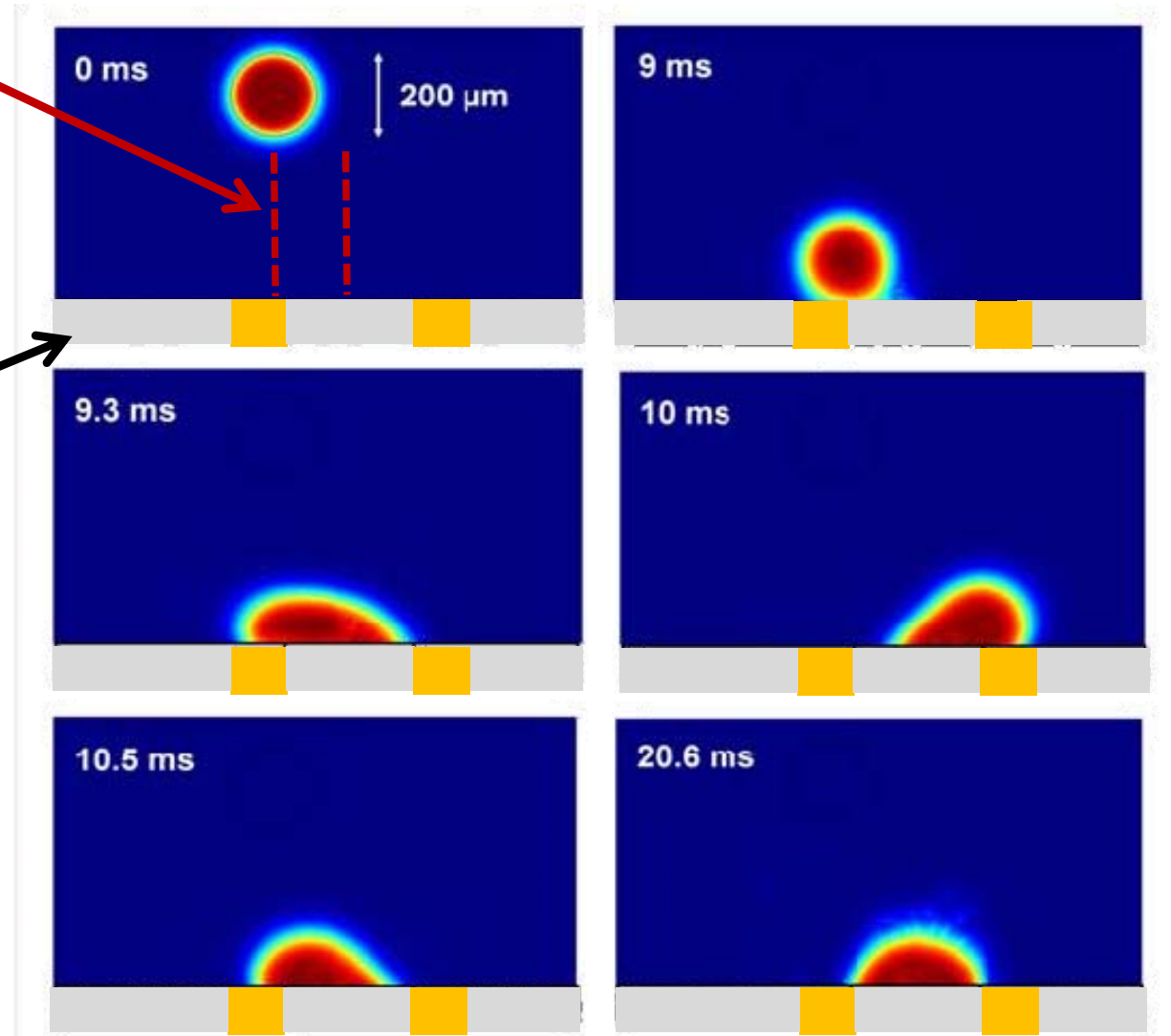
Dimension of hydrophobic ring

Width of hydrophobic ring [µm]

width

hydrophobic ring

Source: IFF/MST

~70µm

Initial displacement

0 ms

200 µm

Source: IFF/MST

Initial displacement from target position [µm]

Source: IFF/MST

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Positioning the droplet

200 µm

Source: FhG/IPA

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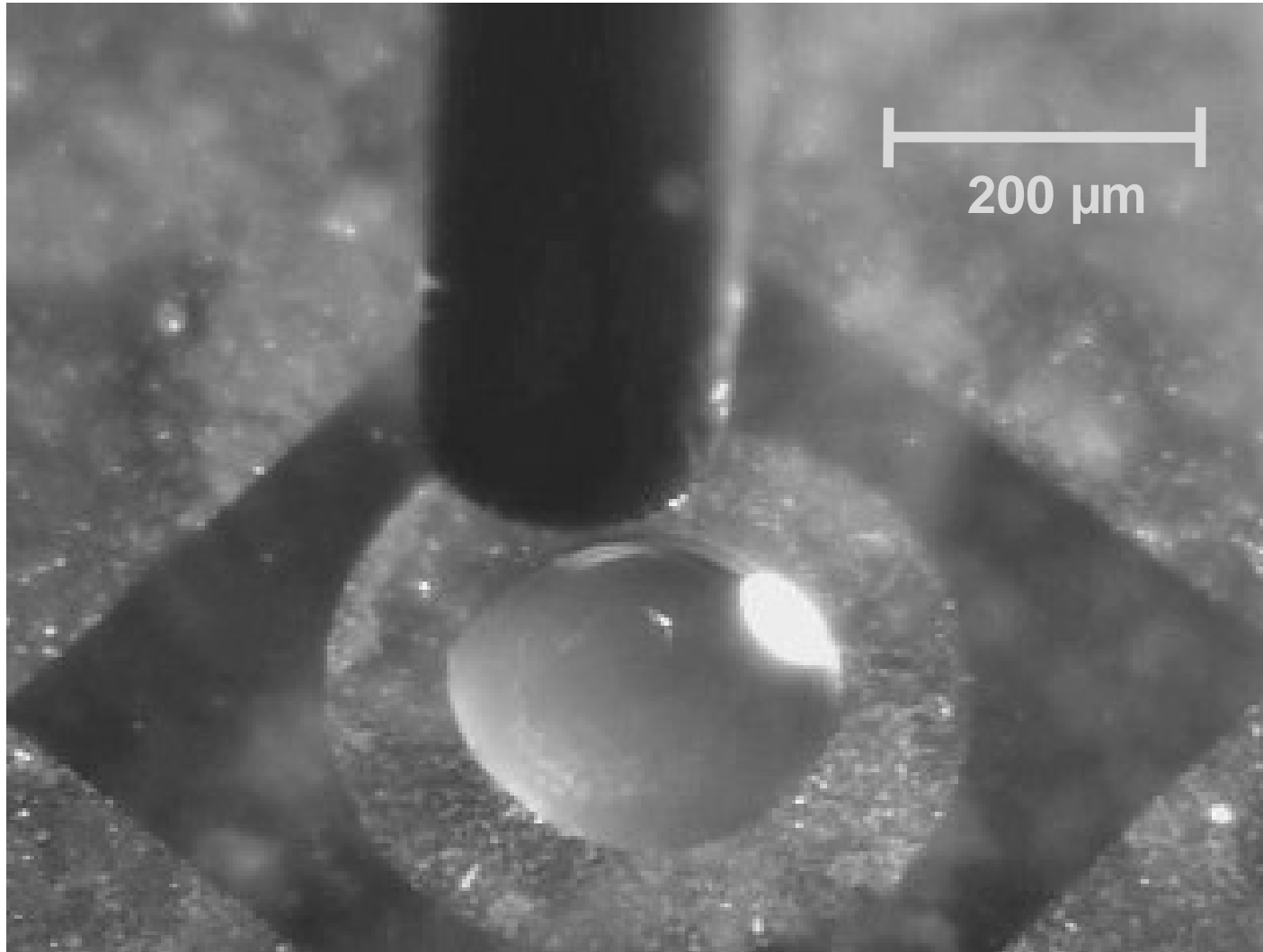
Time for chip alignment

- **Partition of alignment process**

displacement

| Hydrophobic area | Hydrophilic area | Hydrophobic area |

Chip

Chip

Substrate
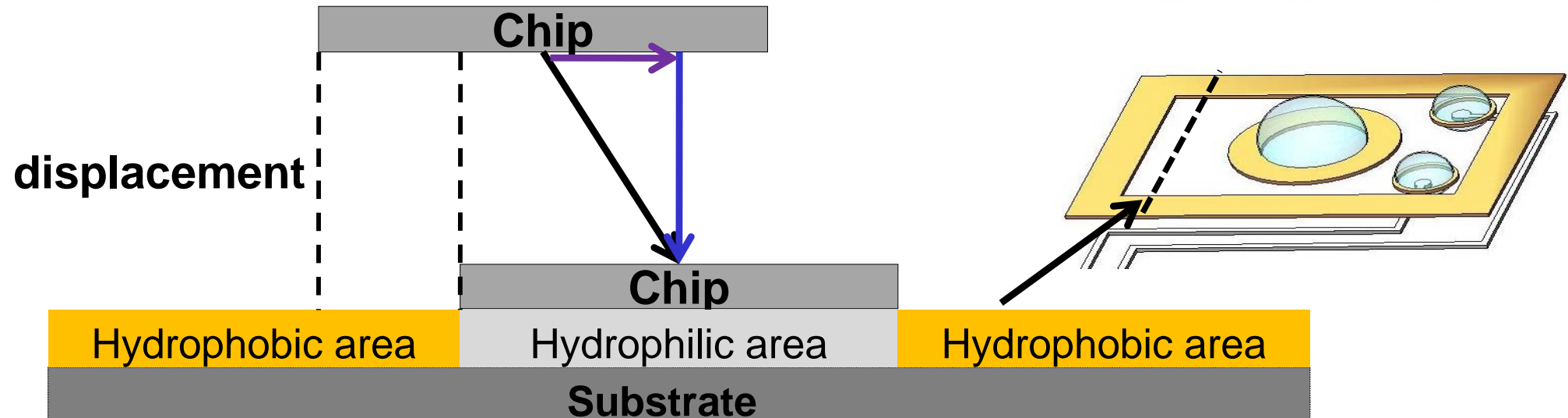
- **Chip-alignment** = **horizontal** + **vertical**

- t_{total} < $t_{horizontal}$ + $t_{vertical}$

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Horizontal chip alignment

Time for horizontal alignment: ~ 0.2 ms

Size of microchip

500 μm

300 μm

100 μm

Time for alignment [ms]

0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00

0%   10%   20%   30%   40%

50 μm

Displacement from final position [μm]

Source: IFF/MST

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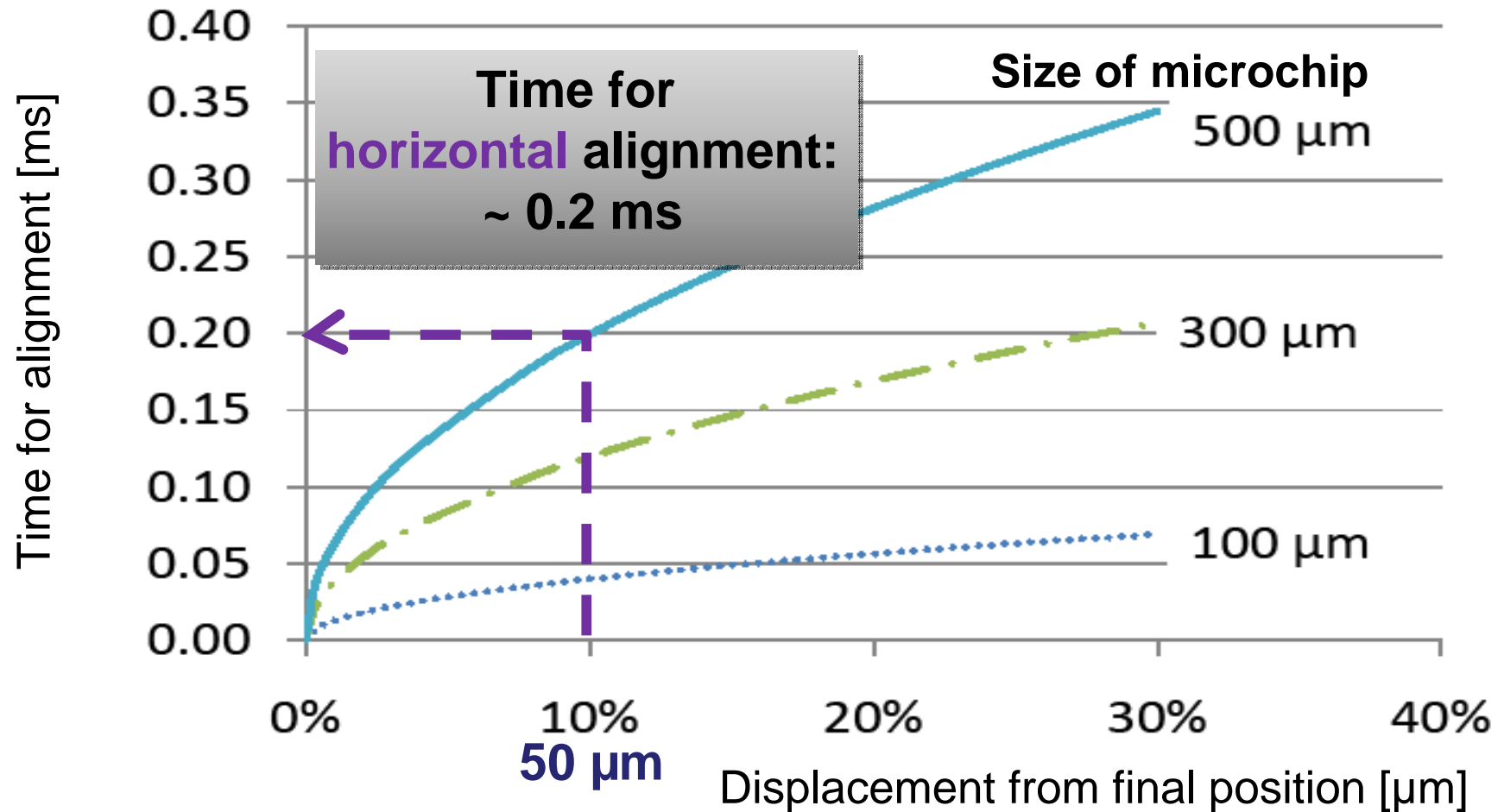
Vertical chip alignment
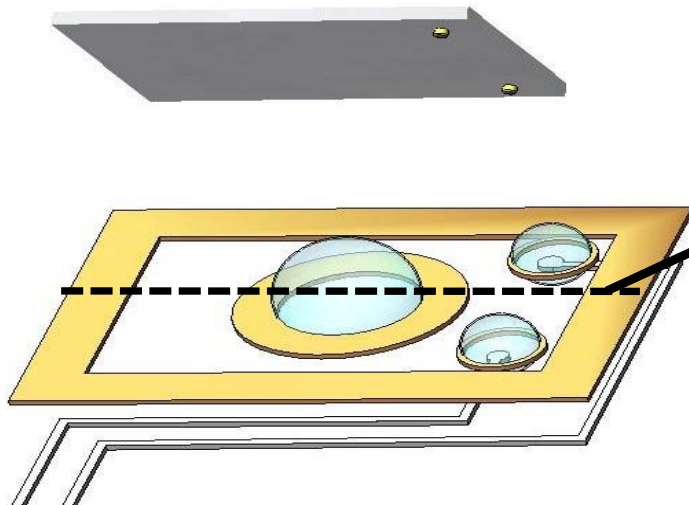
Source: IFF/MST

Time for vertical alignment: ~ 0.7 ms
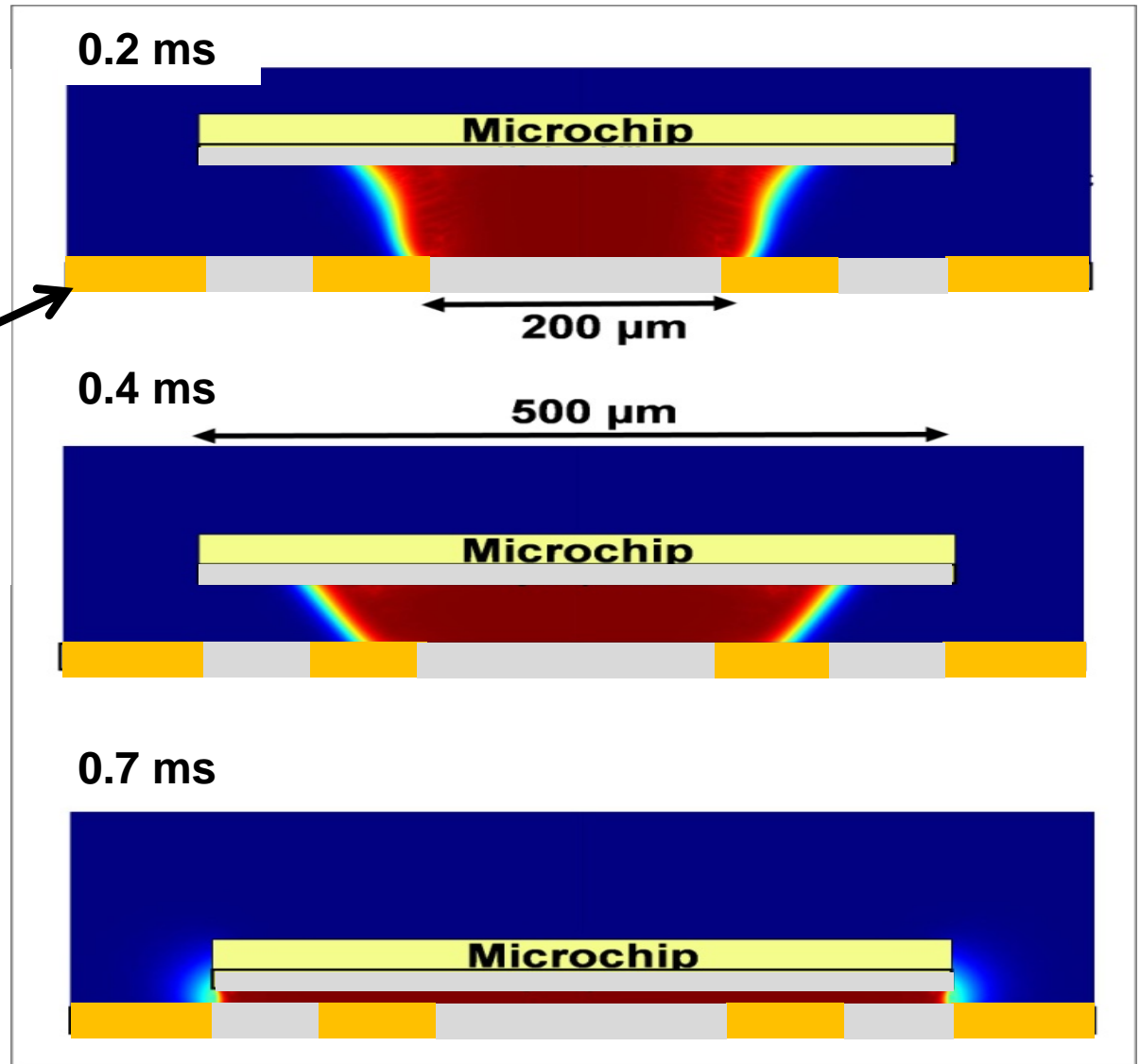
Total time for chip alignment

➢ **Horizontal** ~ **0.2 ms**

➢ **Vertical** ~ **0.7 ms**

Total time < 1 ms

Outline

- ➢ **Motivation**

- ➢ **State of the art**

- ➢ **FluidAssem technology**

- ➢ **Summary**

Summary

- ➢ **A novel assembly method was presented**

- ➢ **Feasibility studies were done**

  - ➢ **Time for droplet positioning   ~ 12 ms**

  - ➢ **Time for chip alignment   ~ 1 ms**

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Thank you
for your attention!

Acknowledgement:
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