

Temporal Transition of Mechanical Characteristics of HUVEC/MSC Spheroids

Using a Microfluidic Chip with Force Sensor Probes

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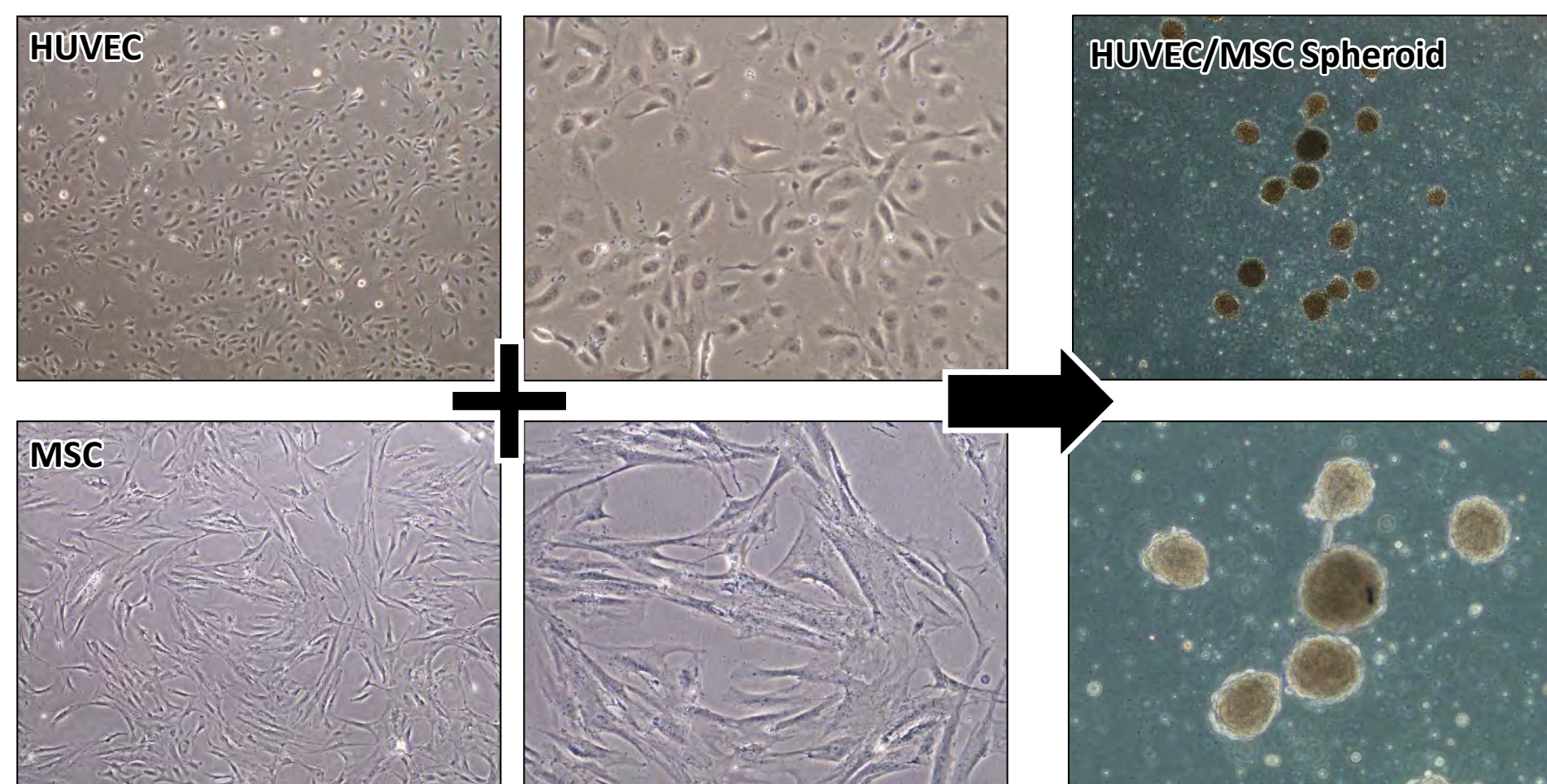
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How to measure the mechanical property of size changing spheroid on a chip?

Background & Purpose: On-chip Cell Mechanical Characterization

HUVEC/MSC spheroid



● HUVEC
● MSC

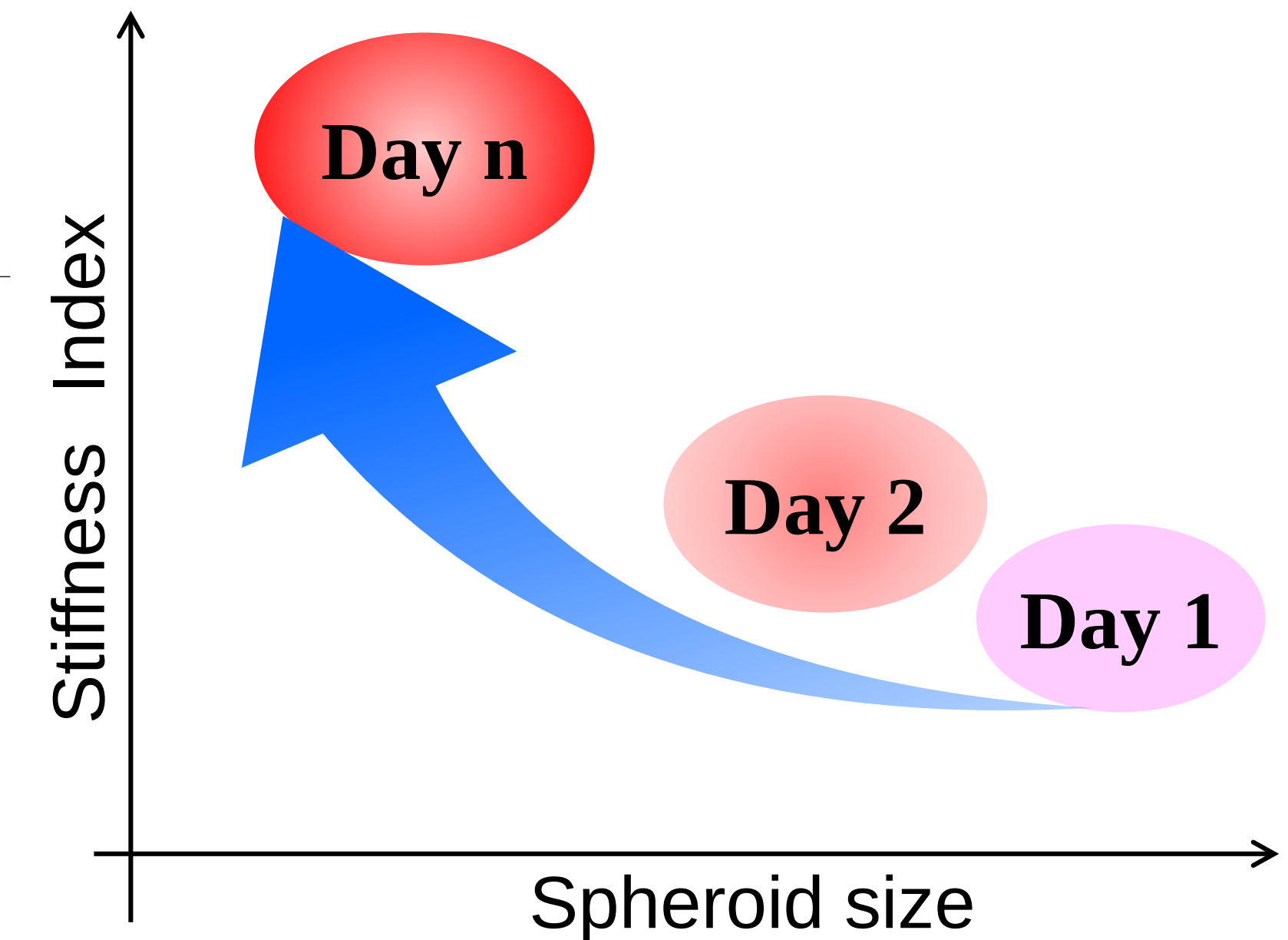
Day 1

Day 2

...

Day n

- Self-assemble
- Usable for vascularization, bone repair
- Size reduction as culture time advance

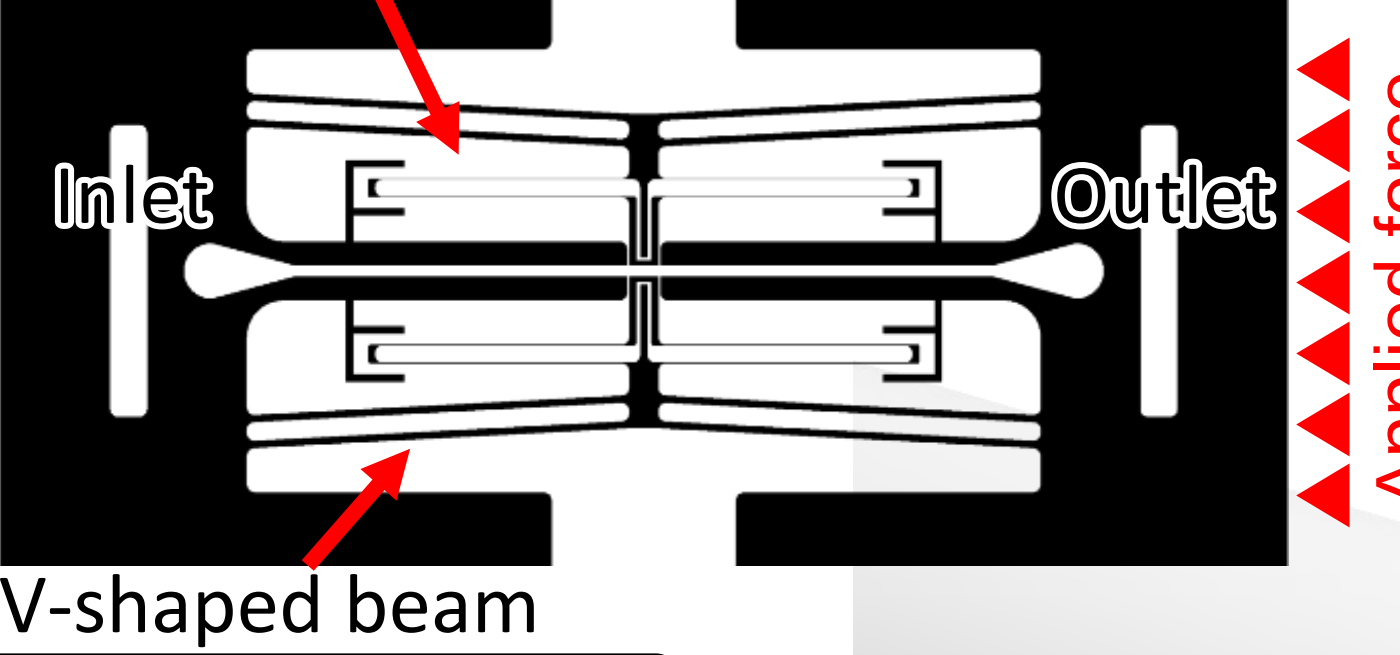


Whole chip deformation mechanism

Basic concept:

Non-contact actuation of on-chip probe

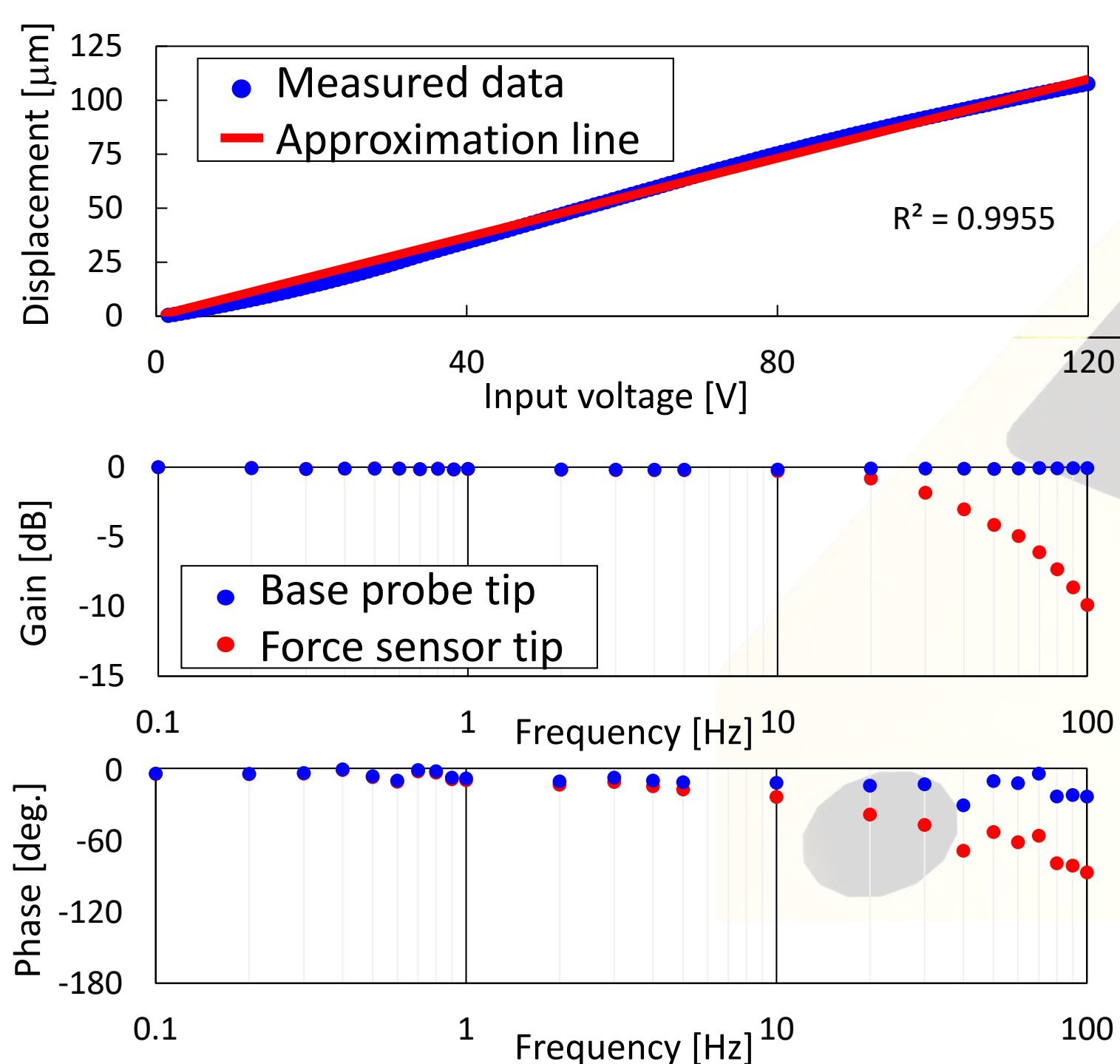
Force sensor probe



Theoretical model

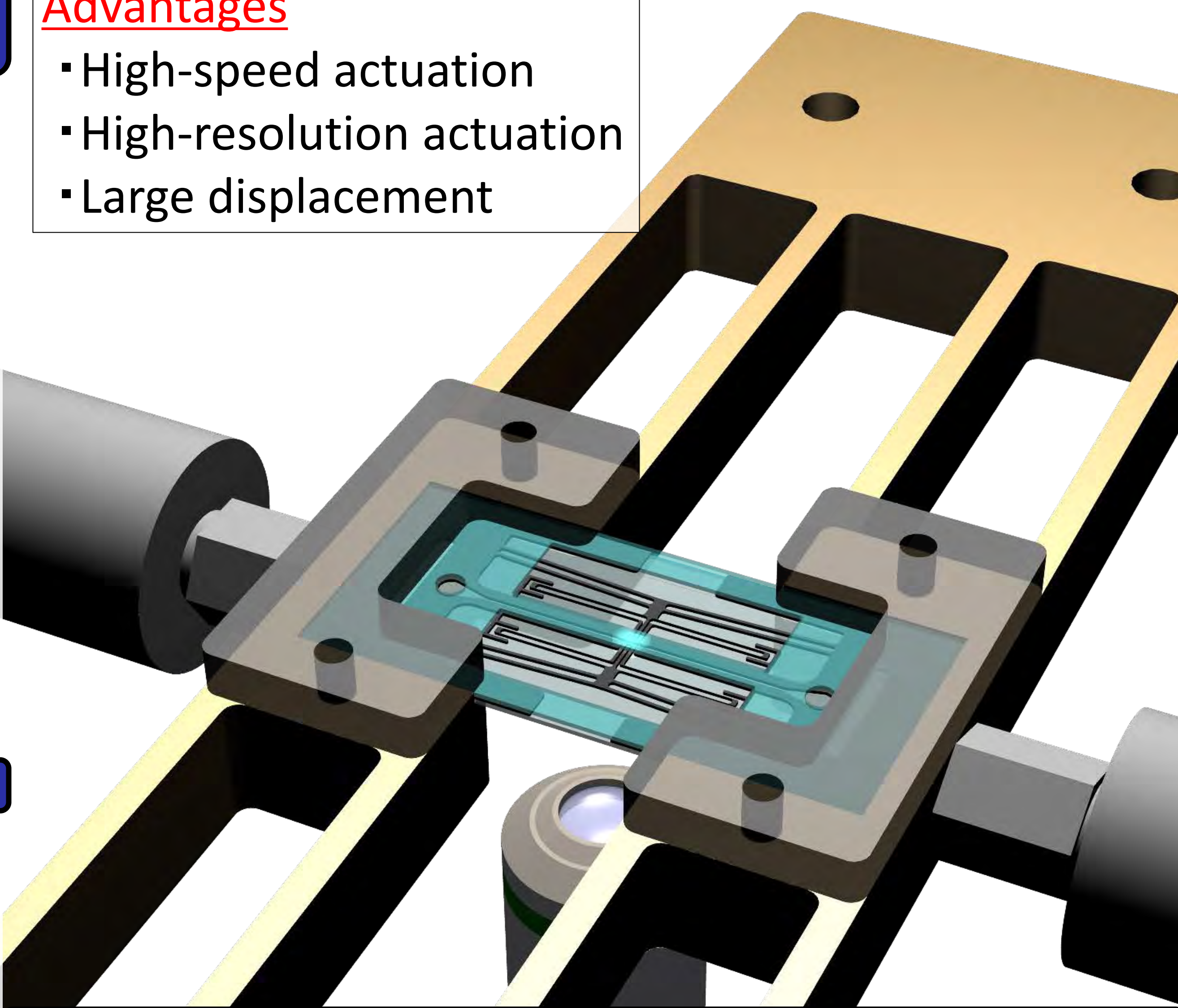
$$\delta_y = \left(\frac{EI}{F} \tan \left(\sqrt{\frac{F}{EI}} \frac{L}{4} \right) - \frac{L}{2} \right) \left(\tan \theta - \frac{f}{2F} \right)$$

Drive performance

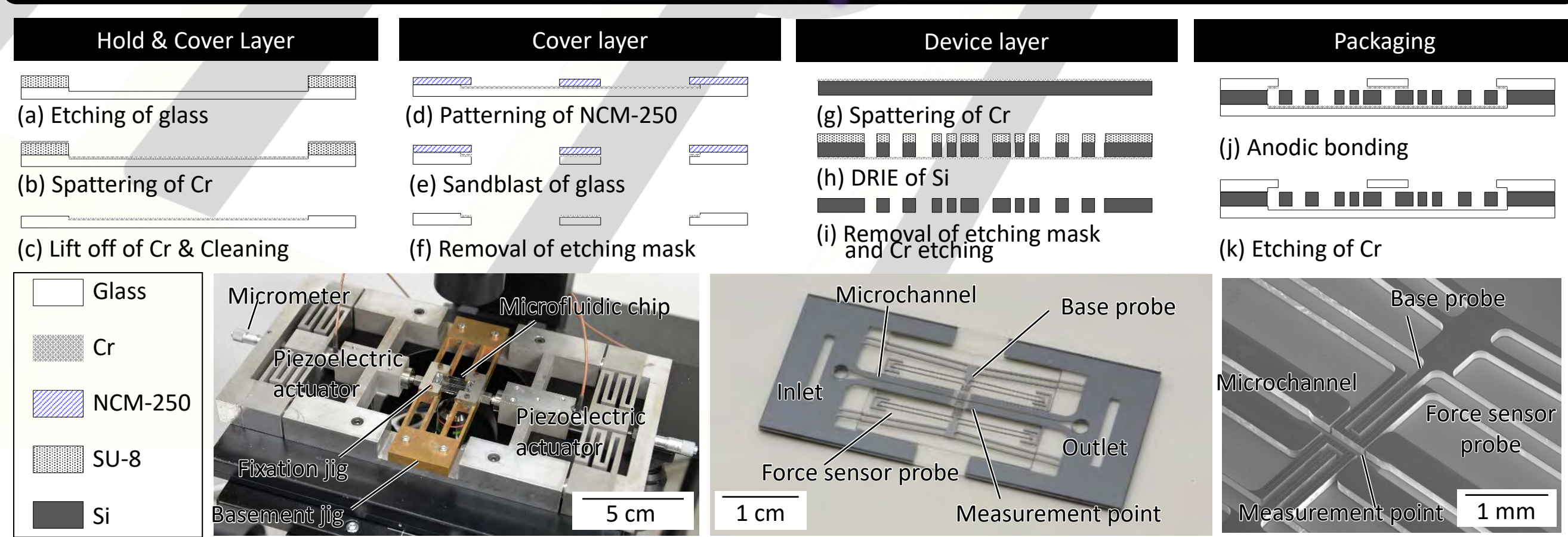


Advantages

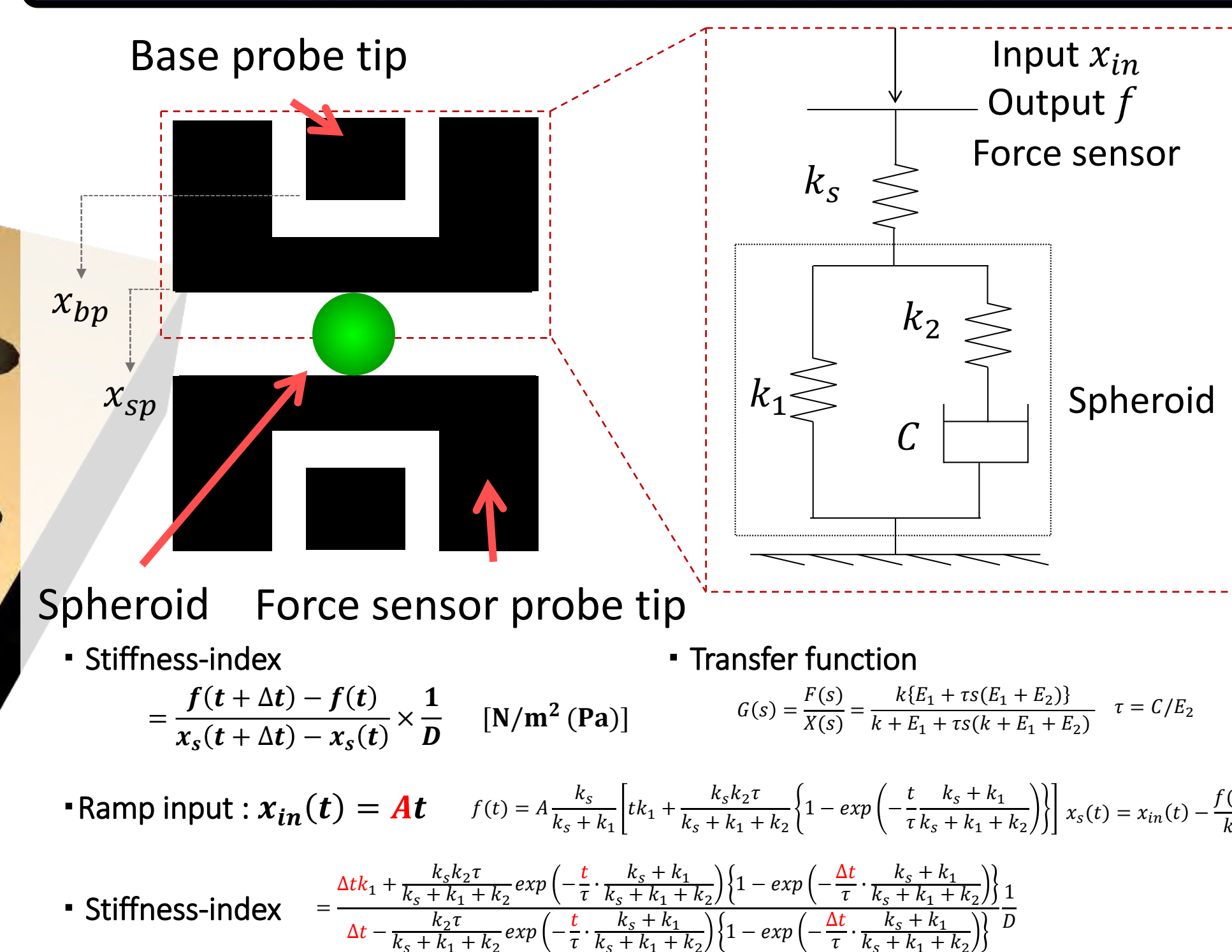
- High-speed actuation
- High-resolution actuation
- Large displacement



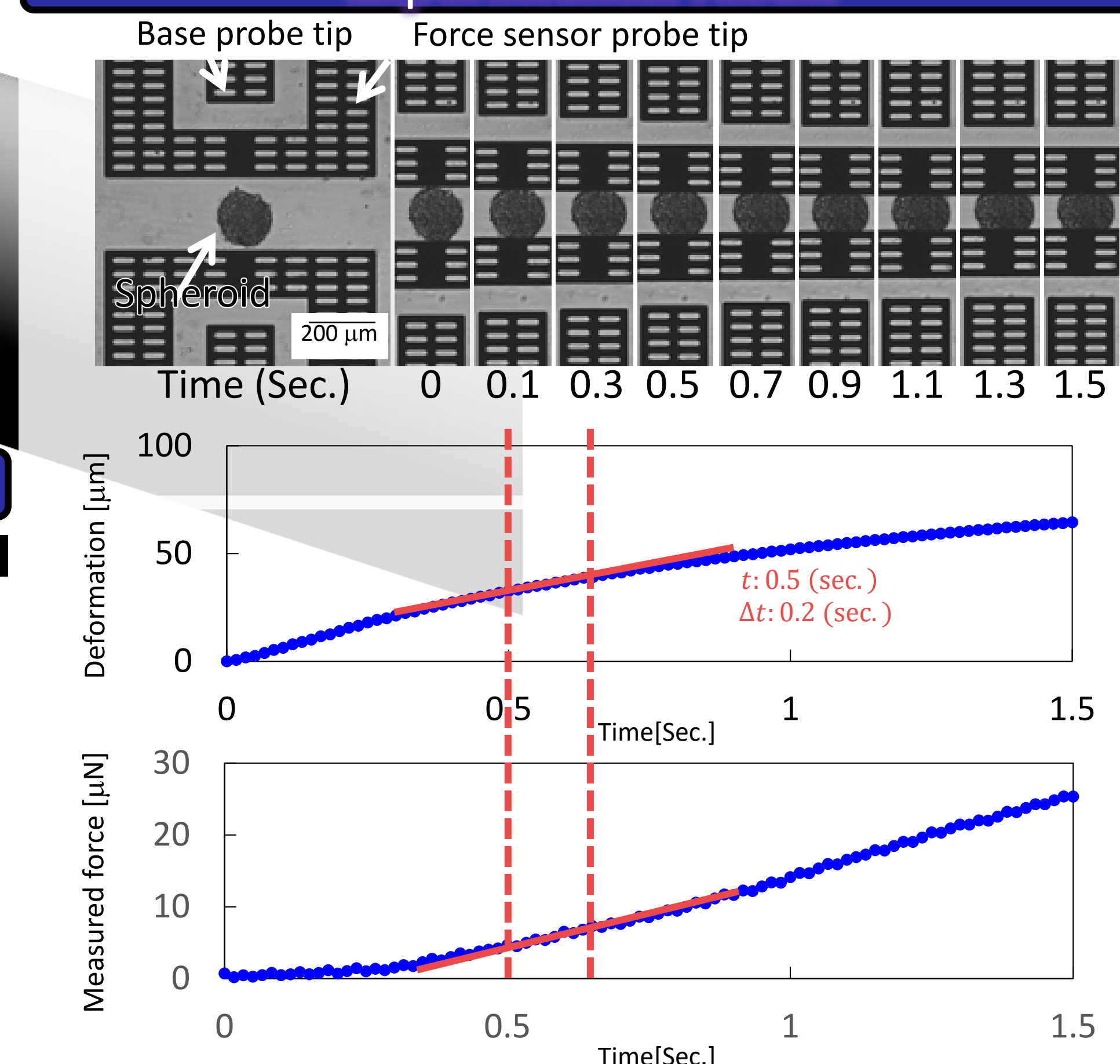
Fabrication process



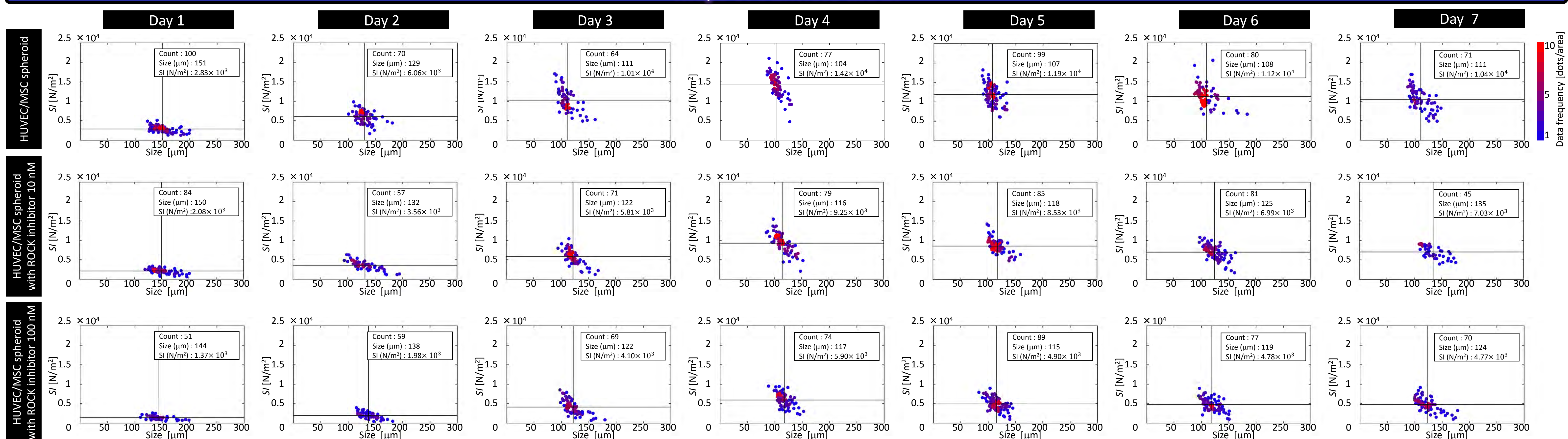
Introduction of Stiffness-Index



Experimental result



Maps of Stiffness-index



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Reference:
伊藤 啓太郎, 佐久間 臣耶, 木村 昌樹, 武部 貴則, 金子 真, 新井 史人, 経時変化する細胞凝集体の硬さ指標評価. ロボティクス・メカトロニクス講演会2016, 2A2-20a2, 2016
Acknowledgements:
This work was partially supported by Kakenhi (23106002) and JSPS (15110992).

