

ISIM2011

International Symposium on Integrated Microsystems

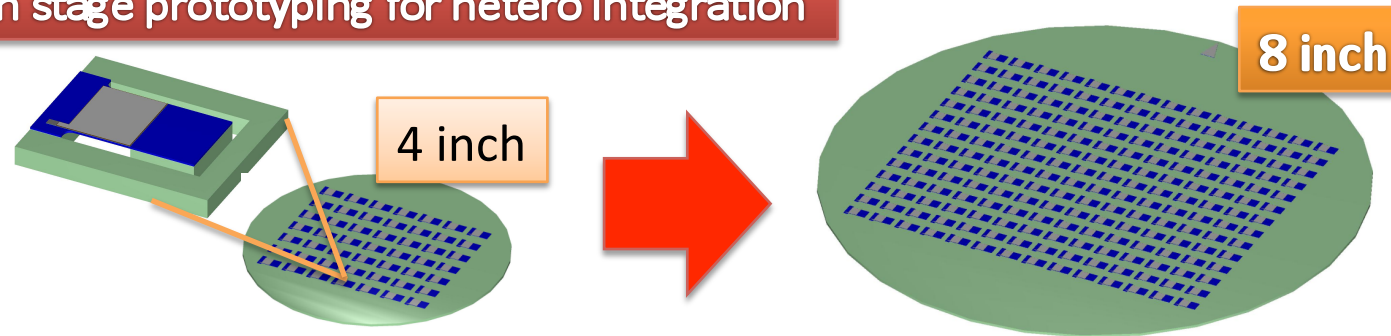
Production stage prototyping for the hetero integration

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S. Matsumoto, H. Okada, Y. Zhang
Z. Gang, H. Funakubo*
AIST and Titech*

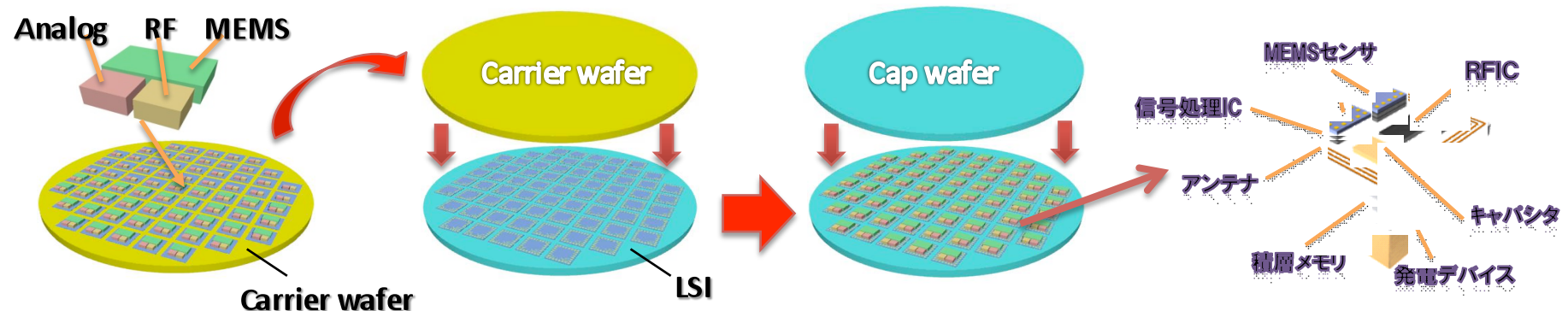


AIST sub theme for first program

Production stage prototyping for hetero integration



High Efficiency Integrated MEMS Production Technology

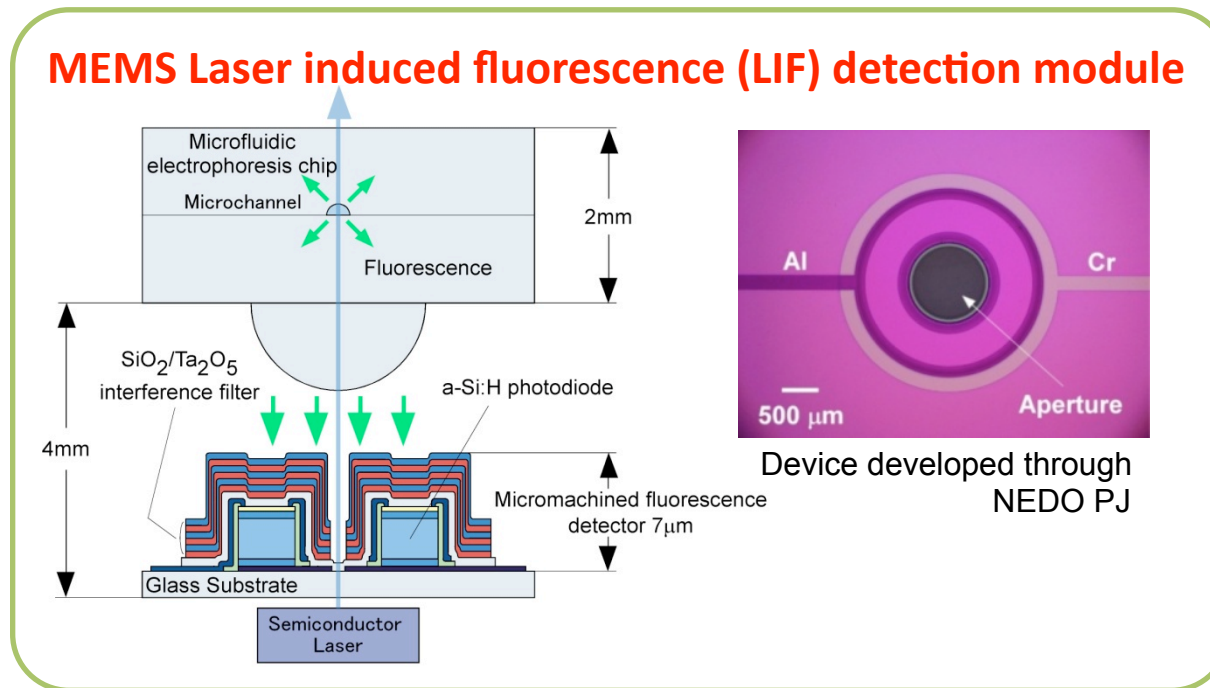


- Production stage prototyping using 8 inch MEMS fabrication line in cooperation with partner companies
- Integration of CMOS circuit and MEMS devices through wafer bonding

Production stage prototyping for hetero integration

Category	Main researcher	Collaborate with	Theme
Microfluidic	<i>Kamei</i>		Point-of-care diagnosis microfluidics
	<i>Inoue</i>	Mitsubishi gas chem.	Microreactor for direct H ₂ O ₂ synthesis
	<i>Yamamotoo</i> <i>Matsumoto</i>	Kyoto electronics	Micro viscosity sensor: η -MEMS
Piezoelectric	<i>Kobayashi</i>	Hirose	Electrostatic field sensor
	<i>Kobayashii</i> <i>Funakubo</i>	Tokyo Inst. Tech.	High speed characterization
Sensor net	<i>Okada</i> <i>Zhao</i>	Tokyo Univ.	Wireless sensor for chicken health monitor
Novel Fabricaiton	<i>Zhao</i>	KST	Cavity wafer
	<i>Zhang</i>	Meltex	3D-MEMS with vertical lamination

Point-of-Care diagnosis microfluidics

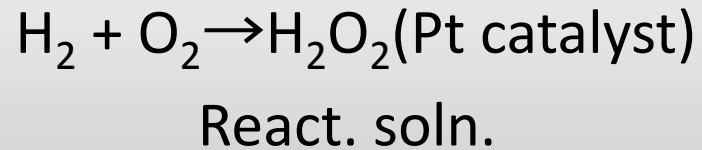


Point-of-Care (POC) rapid clinical & genetic analysis

- Personalized medicine based on genomic and molecular data
- Health Monitor at Home
- Rapid diagnosis at Emergency medical care

Microreactor for direct H_2O_2 synthesis

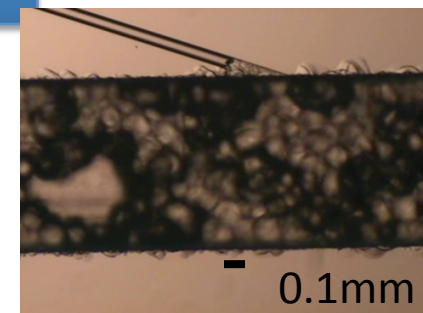
Direct synthesis



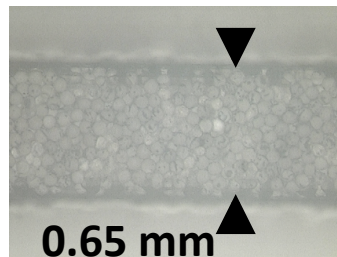
Simple but **EXPLOSIVE**

Our technology

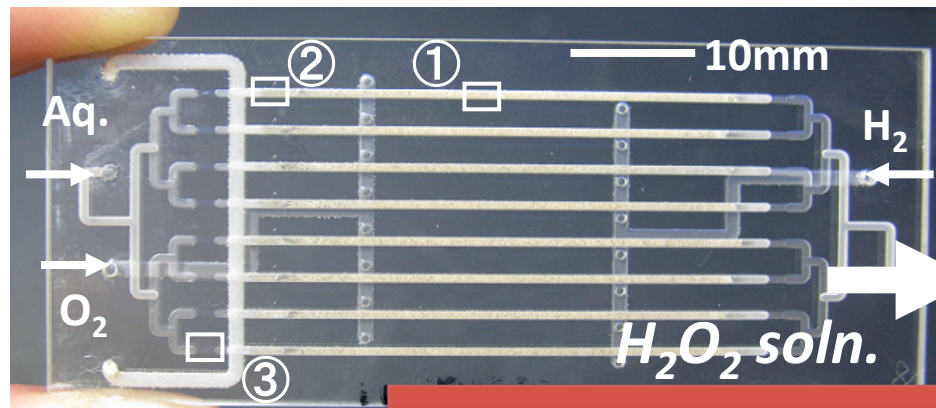
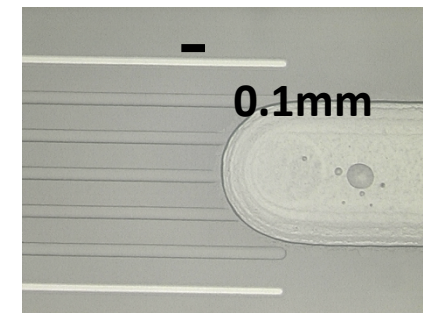
2. Validate proper G-L flow



1. Prevent Flame propagation (explosion)



3. Fabricate flow distribution structure

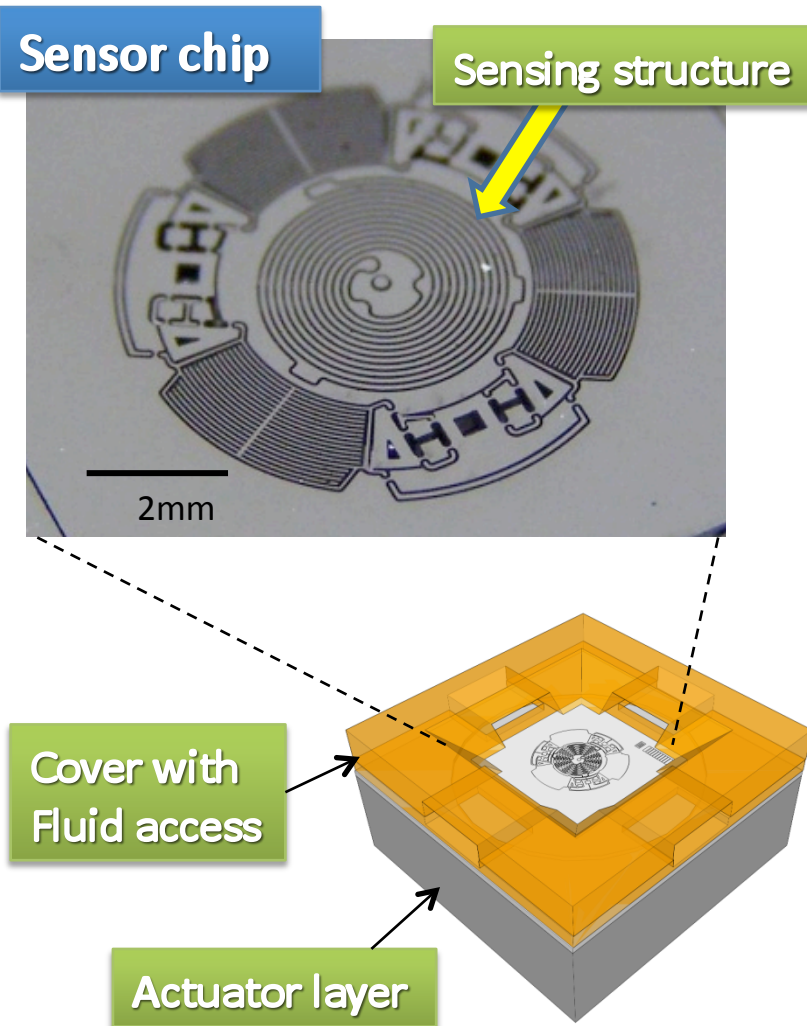


Device developed through NEDO PJ

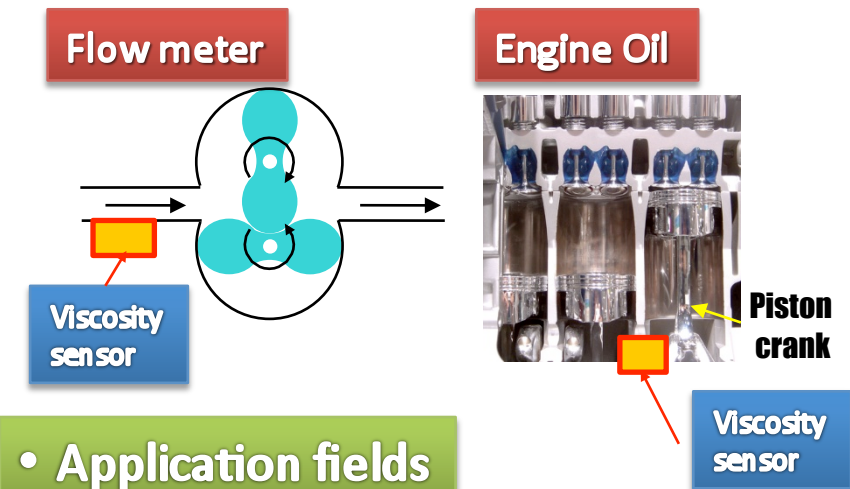
10wt% H_2O_2 @RT, 1 MPa!

Our Goal

MEMS viscosity sensor : η -MEMS



• Process control & Ecology

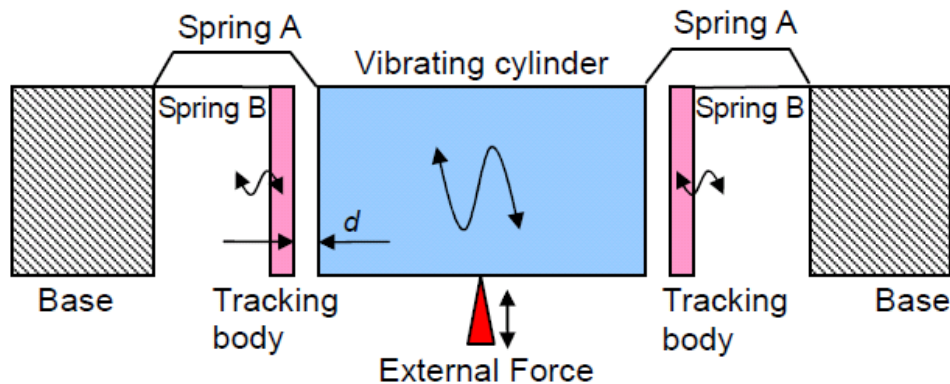


• Application fields



Working principle & structure

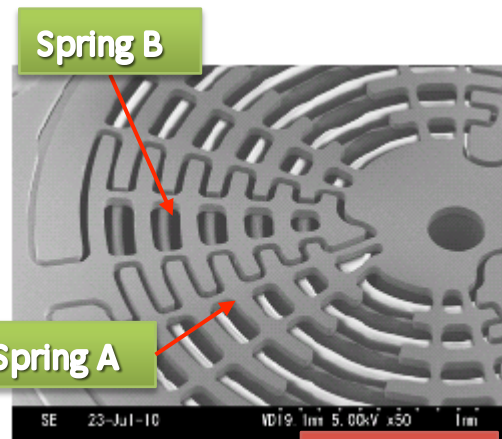
Measurement principle



Structure details



Back side



Front side

Sensor unit assembly

Cover

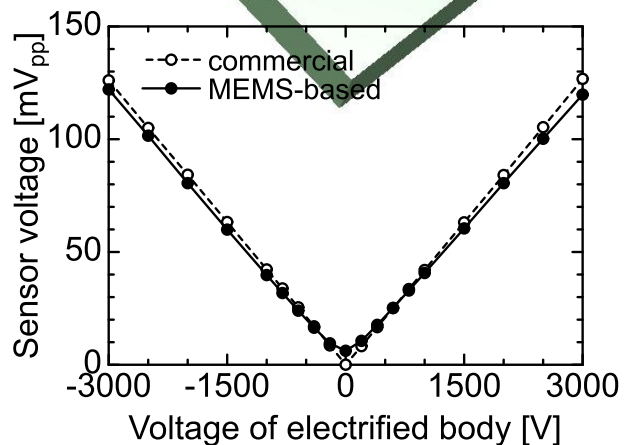
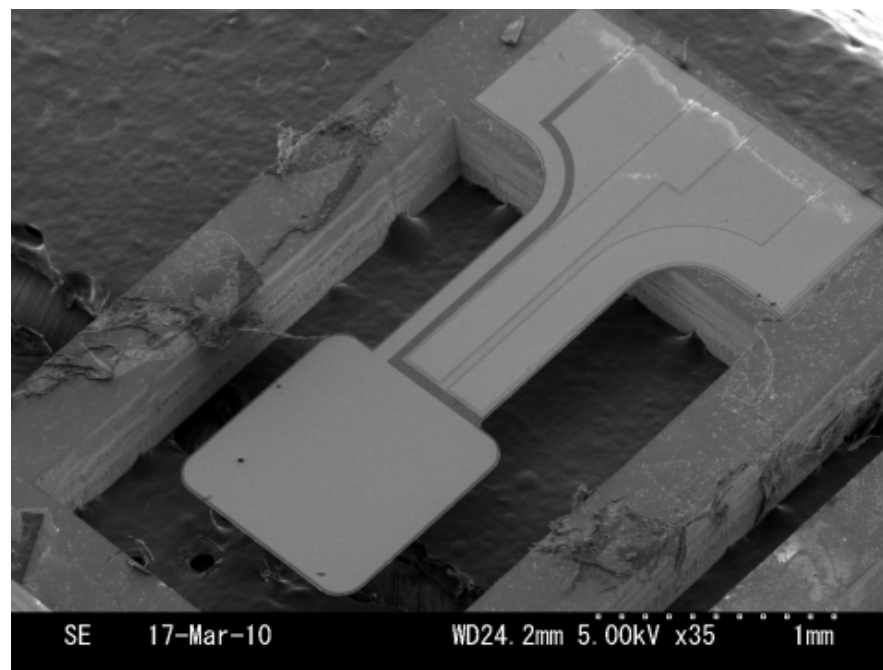
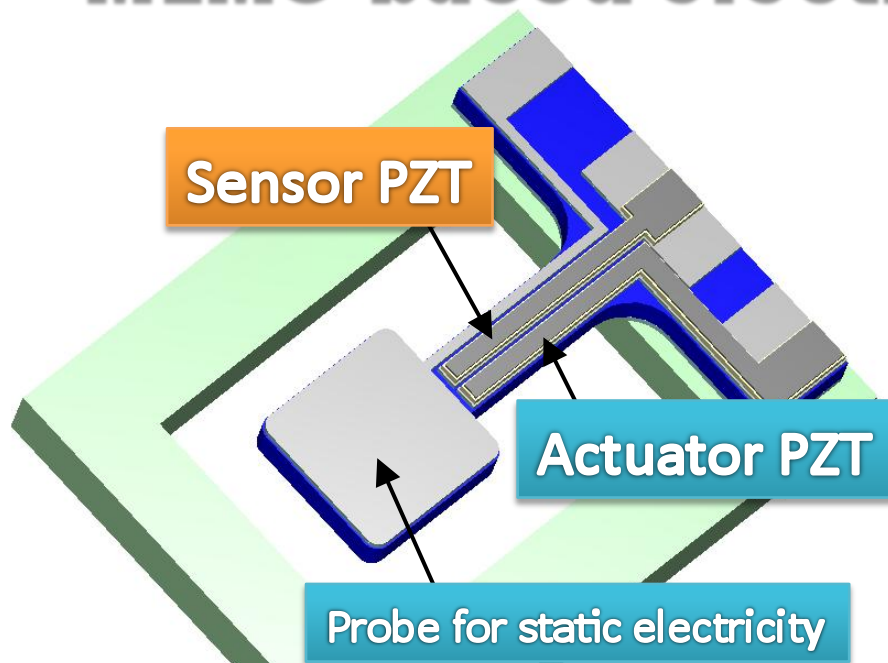
Sensor chip

Chip holder

Diaphragm

Piezo unit

MEMS-based electrostatic field sensor



- 1/10 in volume
- Good sensitivity compatible with commercial sensor

First program

- Custom LSI circuit
- Large wafer scale MEMS fabrication

High speed characterization

Pt/Ti/PZT/Pt/Ti/SiO₂ on SOI wafer

1: Top Pt: Ar ion

2: PZT: HF+HNO₃+HCl

3: Bottom Pt/Ti: Ar ion

4: SiO₂: CHF₃ RIE

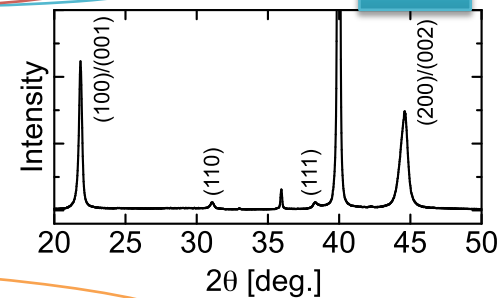
4: Structural Si: SF₆ RIE

4: SiO₂: CHF₃ RIE

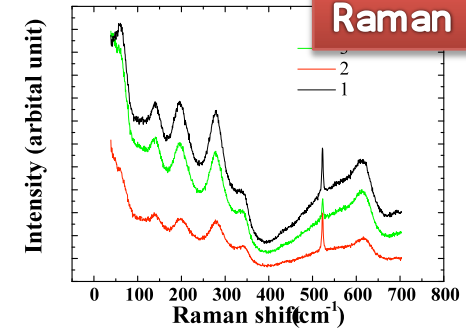
5: Substrate Si: SF₆ DEEP RIE

5: SiO₂: CHF₃ RIE

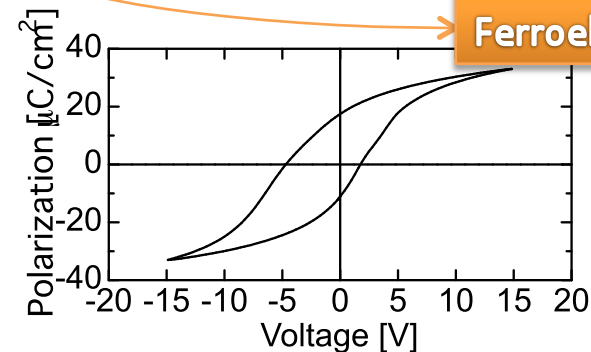
XRD



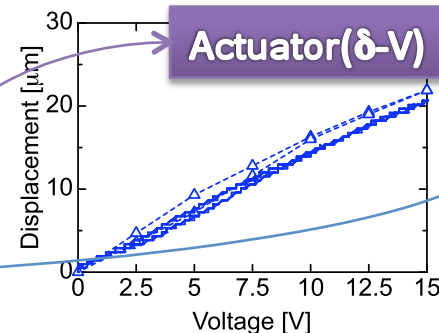
Raman



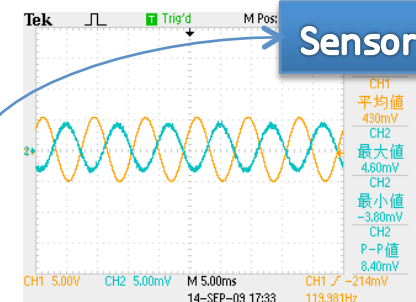
Ferroelectric test



Actuator(δ-V)



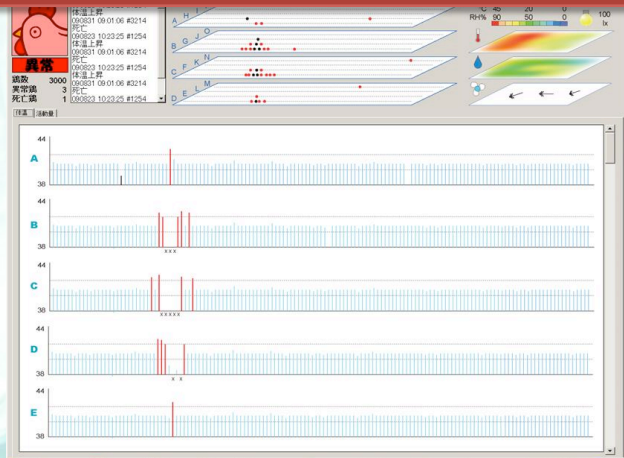
Sensor



Wireless sensor for chicken health monitoring

Wireless sensor node

Body Temp. & acceleration monitoring
by MEMS-based sensors



Avian influenza DB



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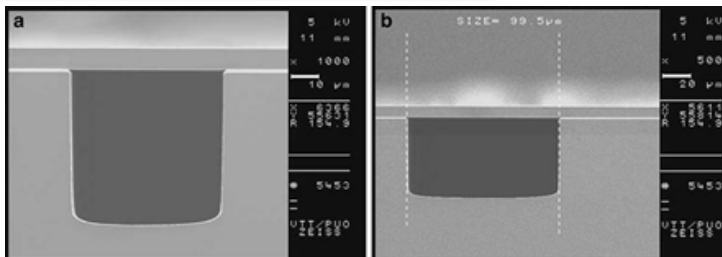
Cavity wafer for MEMS

Cavity wafer



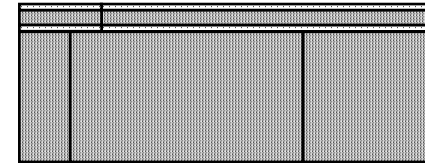
- Reduction of DRIE time and SF_6
- Device formation only by front process
- Adjustable gap between device and substrate
- Better handling than through hall etched wafer

Previous results by VTT

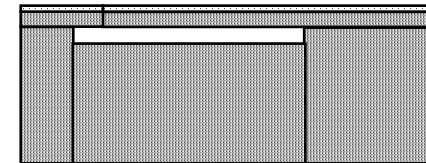


T. Suni et al., MST, 12 (2006) 406

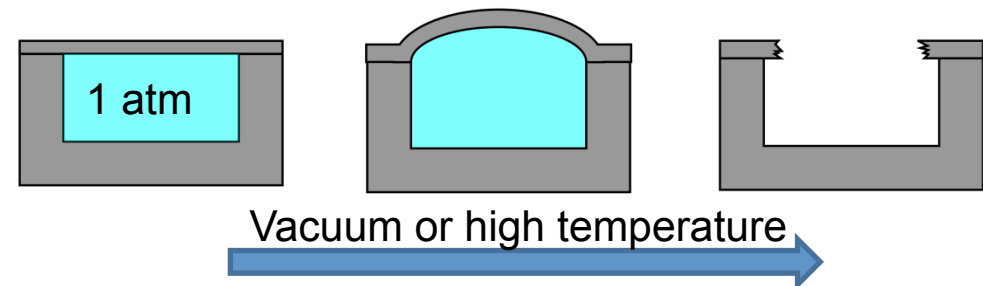
Conventional SOI wafer



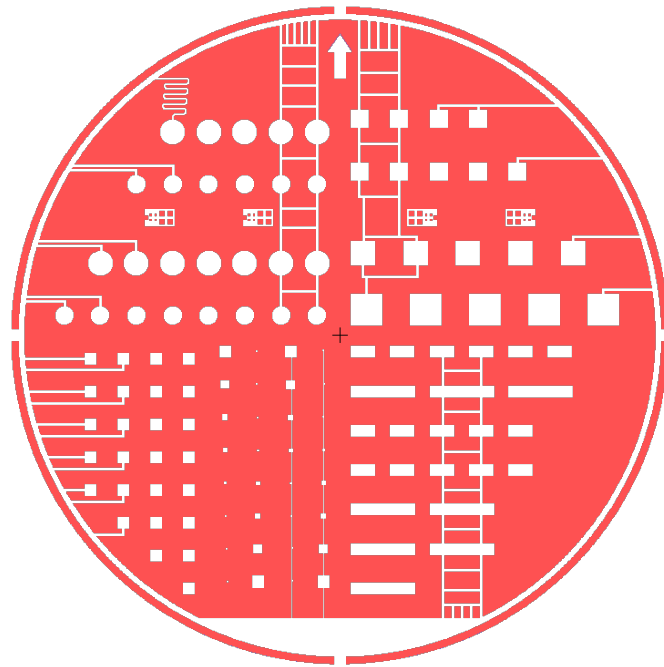
Cavity wafer



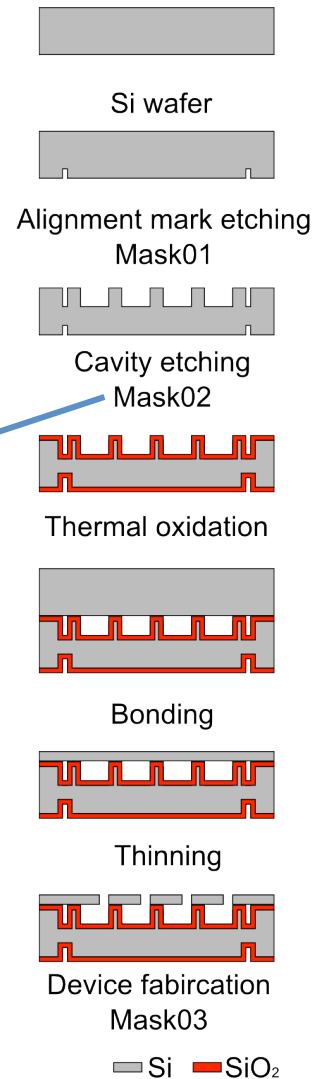
Problem for sealed cavity



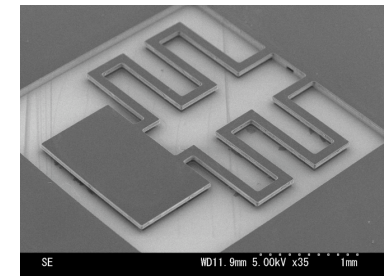
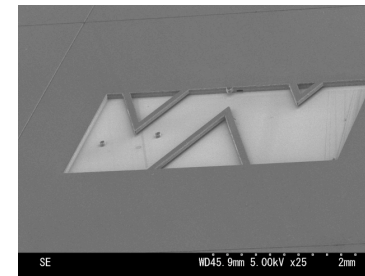
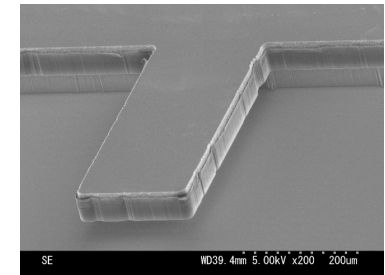
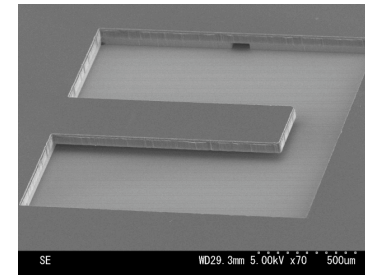
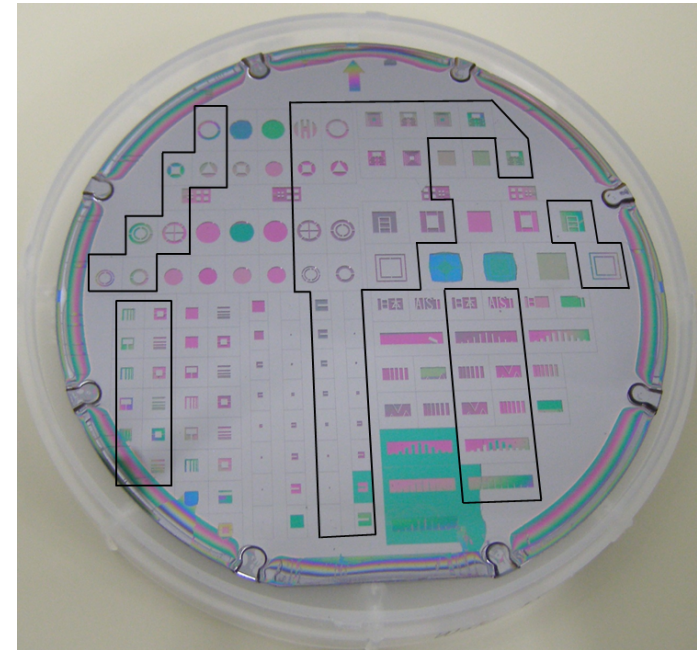
Fabrication process



- Mask for cavity etching:
Trench to avoid deformation
by atmospheric pressure and
burst by heating



- Process flow



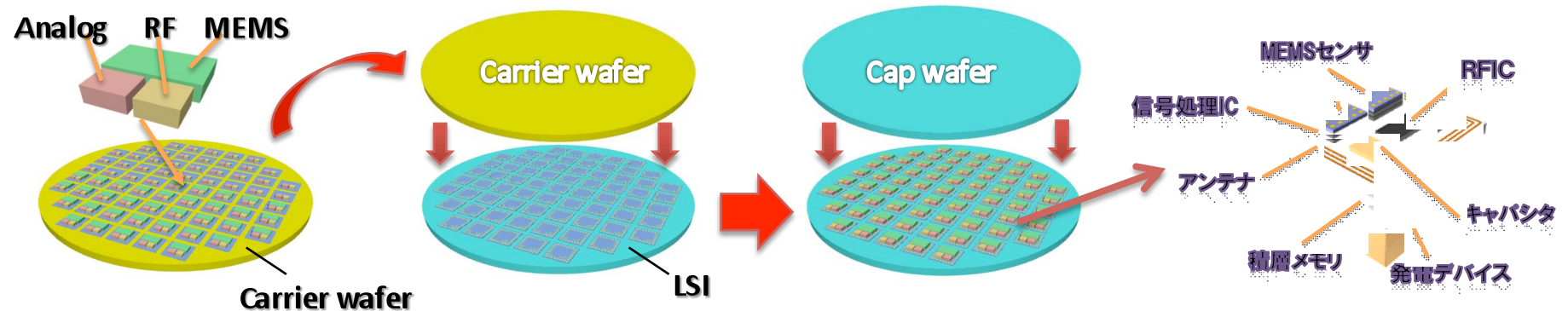
- Some structures based on cavity wafer

Summary

Production stage prototyping for hetero integration



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