# Trial Fabrication and Estimation of Cavitation Sensor with Hydrothermally Synthesized PZT

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**Ultrasound diagnosis**

- Color Doppler imaging
- Harmonic imaging
- 3-dimensional imaging

**Ultrasound treatments**

- HIFU (High Intensity Focused Ultrasound)
- SDT (Sono Dynamic Therapy)

**Investigation of effects of acoustic cavitation on biological safeness by exposure of such high intensity ultrasound**

**Hydrophone**

- It dose not have the spatial resolution

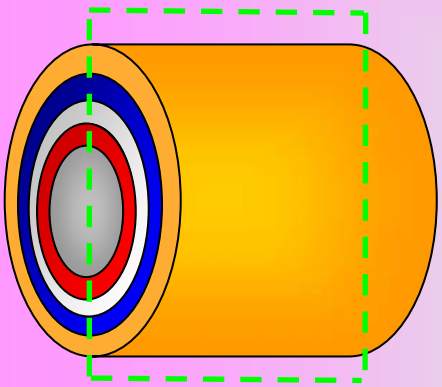
**Conventional cavitation sensor**

- It is difficult to miniaturize
- The piezoelectric element and electrode were damaged by cavitation

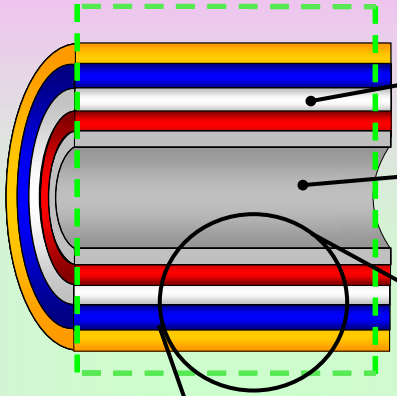
The cylindrical sensor can detect only the acoustic cavitation which is generated inside of cylinder pipe of the sensor

It aims at the development of a small and long lifetime sensor by using features of the hydrothermal method

# Structure of our fabricated cavitation sensor with hydrothermally synthesized PZT polycrystalline film



Cross section



Signal electrode

GND electrode

Titanium pipe

PZT polycrystalline film

Electrically conductive adhesive

Acoustic isolator (Cell sponge: 3 mm)

Electrostatic shield

Fabricated cavitation sensor with hydrothermally synthesized PZT film

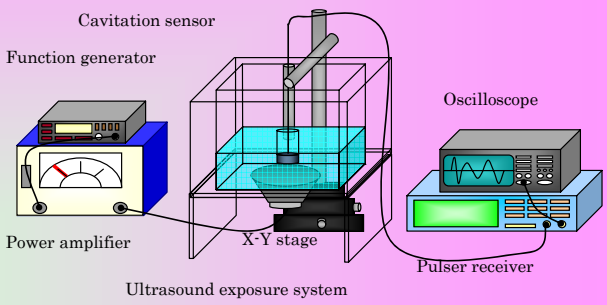
Magnified cross section

# Measurement of cavitation with fabricated sensor

Frequency components from 1 to 5 MHz included in the output signal from the cavitation sensor can be measured as the cavitation signal in order to distinguish from the harmonic components by nonlinear propagation in water and those by acoustic cavitation.

Broadband integrated voltage can be calculated by integrating harmonic components from 1 to 5 MHz included in the output signal from the cavitation sensor.

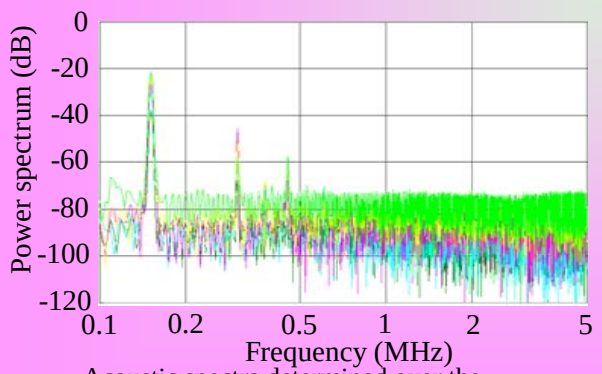
Broadband integrated voltages were measured as the cavitation signal.



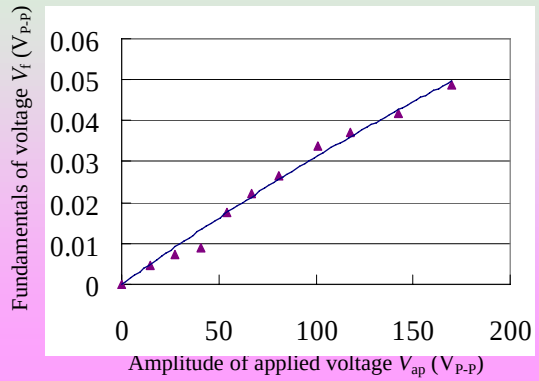

Measurement system with cavitation sensor.

$$V(f) = \int_{-\infty}^{\infty} v(t) \cdot e^{j2\pi ft} dt$$

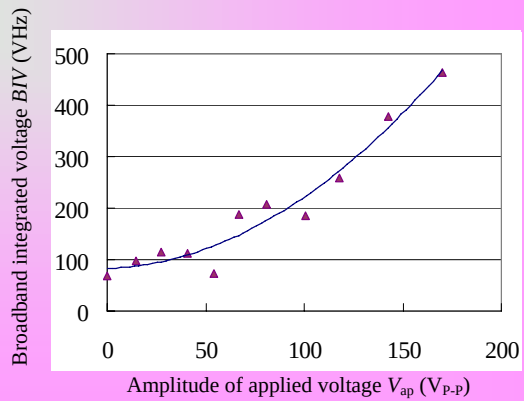
$$BIV = \int_{1\mathrm{MHz}}^{5\mathrm{MHz}} V(f) df$$




Acoustic spectra determined over the frequency range of 0.1 to 5 MHz




Relation between amplitude of applied voltage and fundamentals included in wave form from cavitation sensor.




Relation between amplitude of applied voltage and broadband integrated voltage.