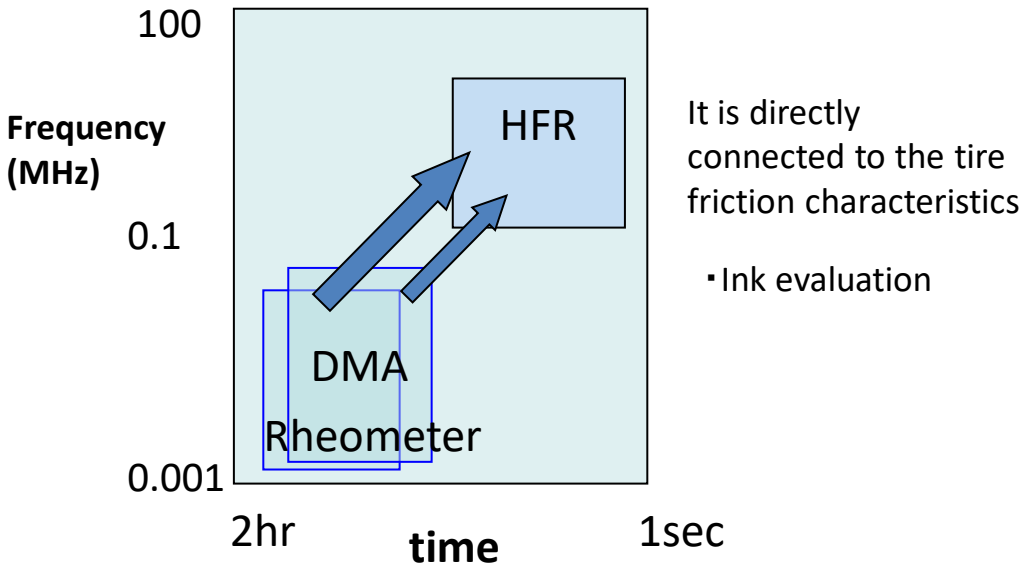
OUTLINE of HFR

Highfrequency Viscoelasticity Corporation

To realize the 3R that are desired in the industry

- It has specialized in the high frequency region
- It can be measured in the field environment (Real condition)
  （Unnecessary cryostat　Unnecessary temperature-time conversion）
- Short measurement time (Real time)
- You can measure the actual thing (Real sample)



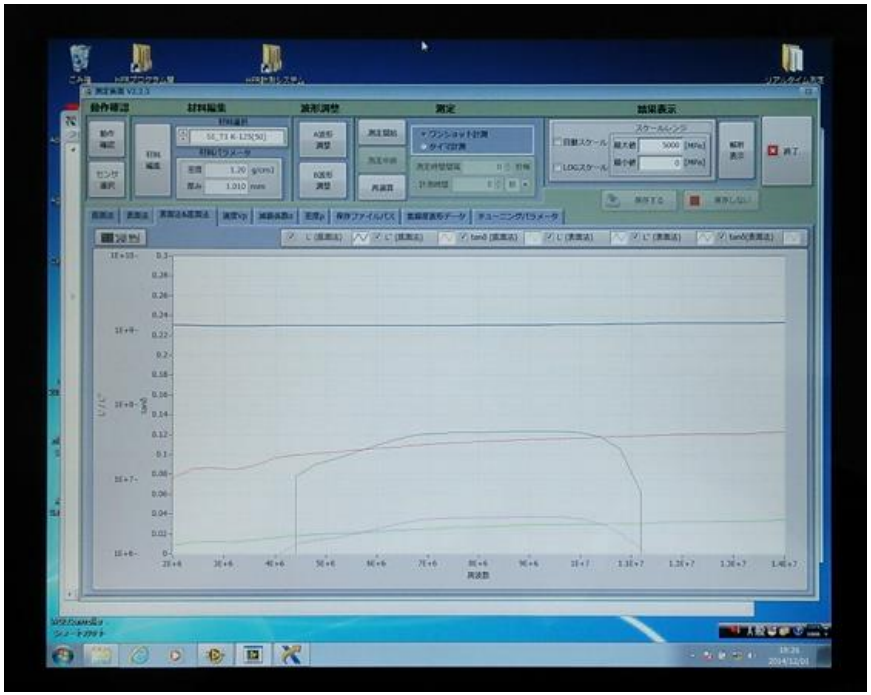
It is directly connected to the tire friction characteristics

- Ink evaluation

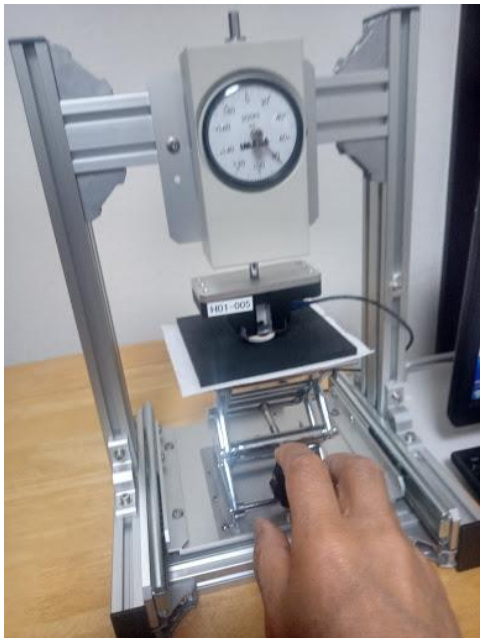
Features of the highfrequency viscoelasticity measurement apparatus HFR002

- Unnecessary calculation of troublesome ultrasonic measurement
- Viscoelastic measurement results display a spectrum
- The numeric data in Excel output
- It can also be measured of time-varying sample by Timer measurement

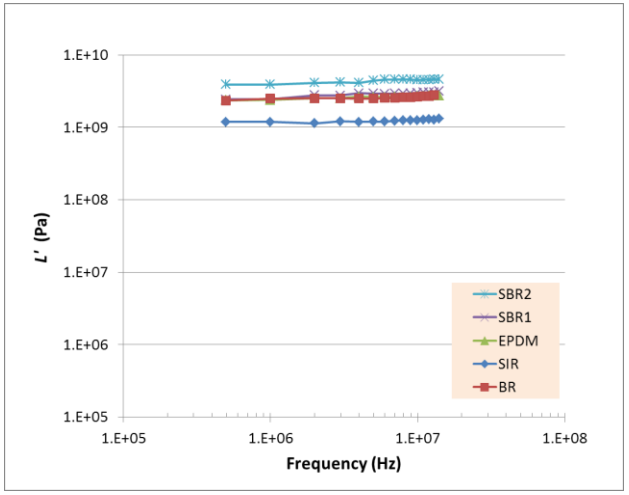
Measurement result display screen

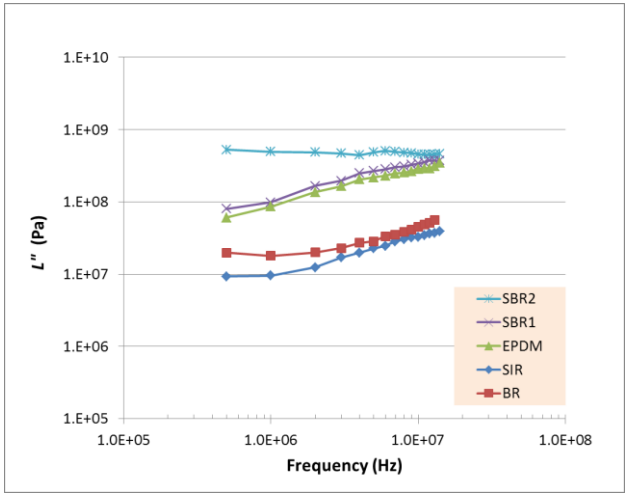


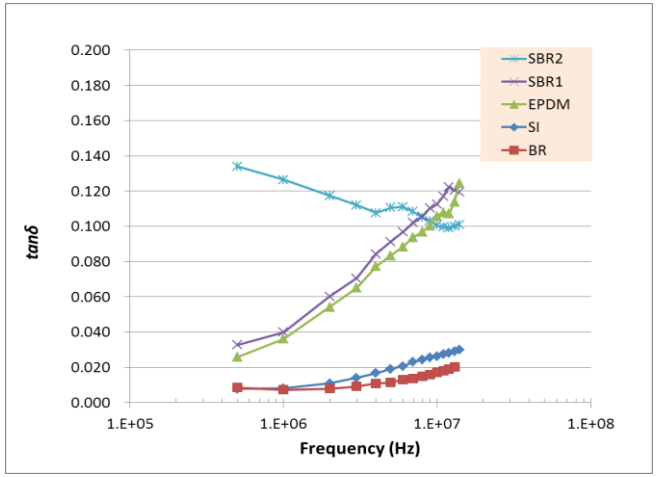
Sensors and sample



Measurement example of highfrequency viscoelastic properties of rubber







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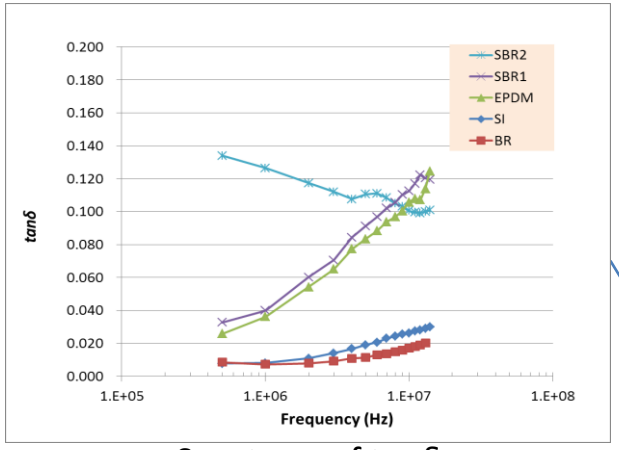
Correlation between a functional properties

MHz band viscoelastic properties can be measured easily by using high frequency viscoelastic measurement apparatus HFR. So it became possible to study correlation between a functional properties (e.g. friction) and high frequency viscoelasticity in the actual operating temperature.

HFR



Spectrum of tanδ.

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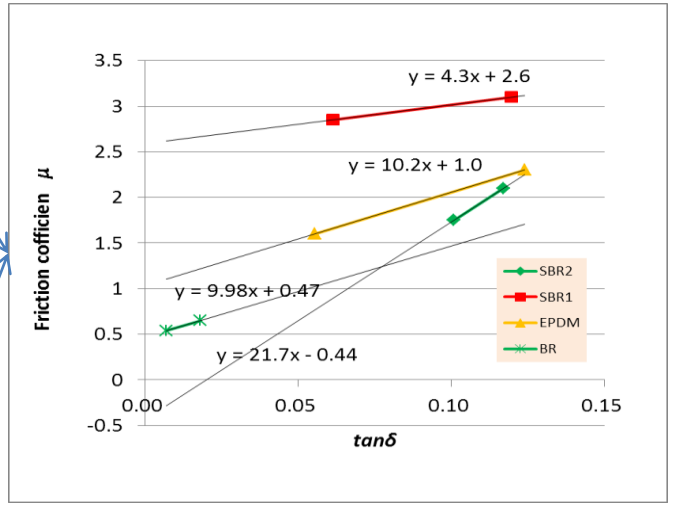
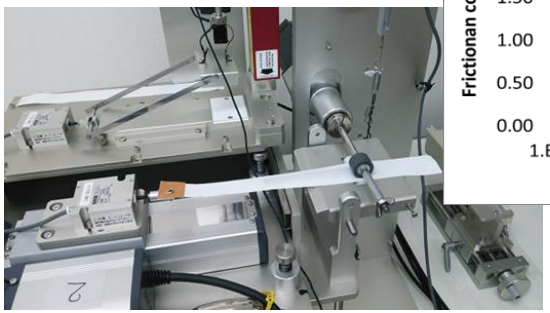
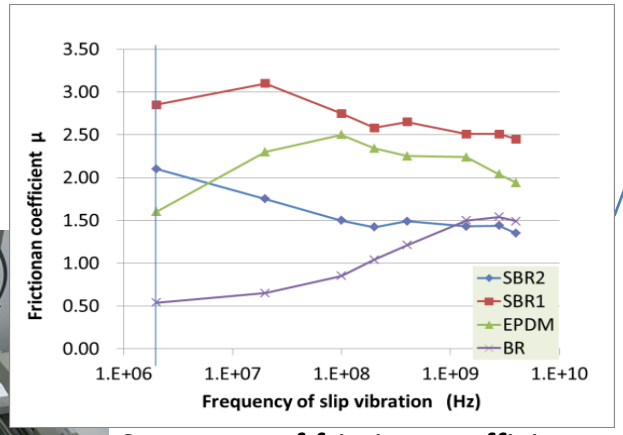


Correlation between tanδ and friction coefficient.

RRL





Spectrum of friction coefficient μ.

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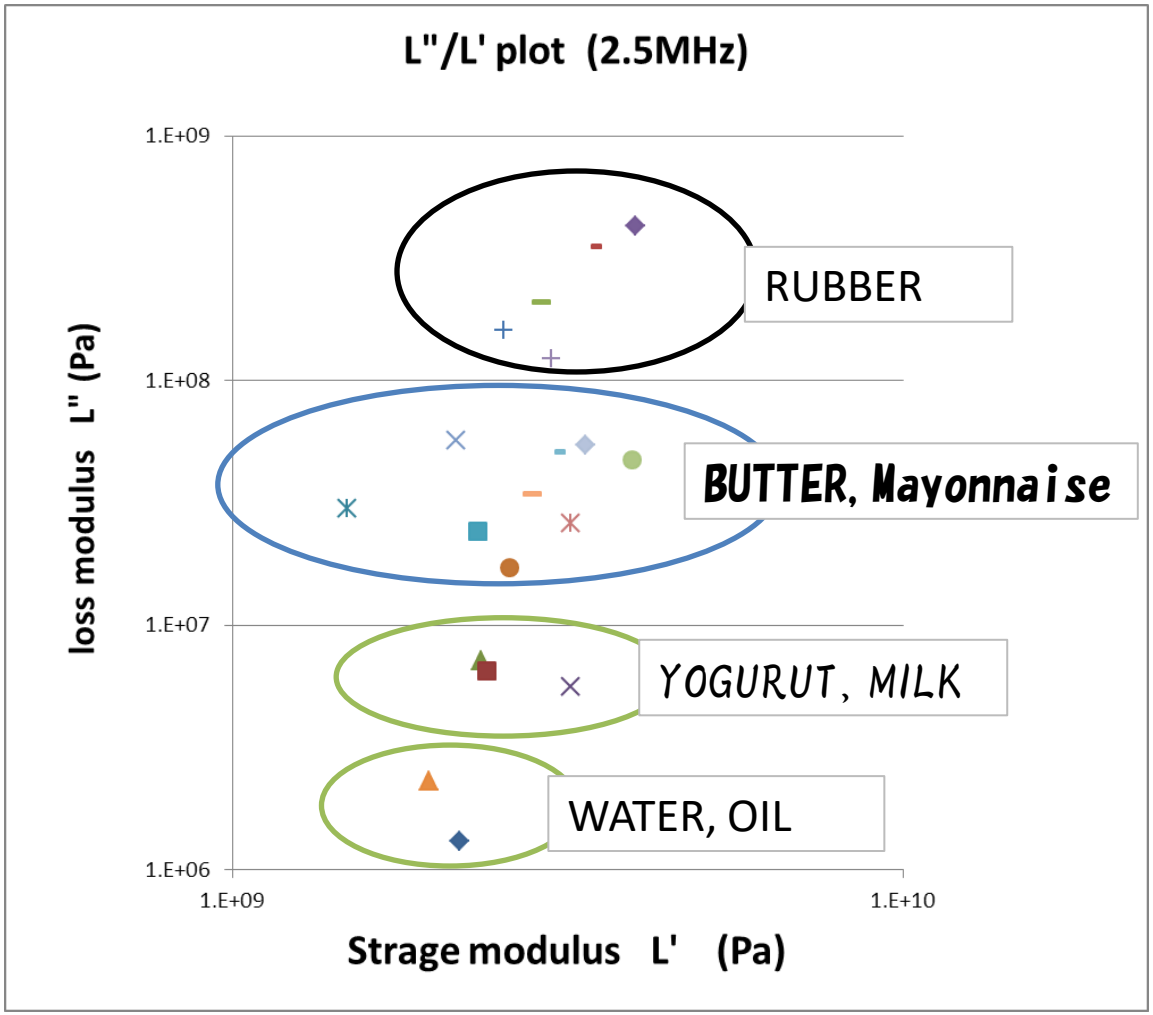
$$F = F_h + F_a = K \cdot E'^{-\frac{1}{3}} tan\delta + A \cdot s$$

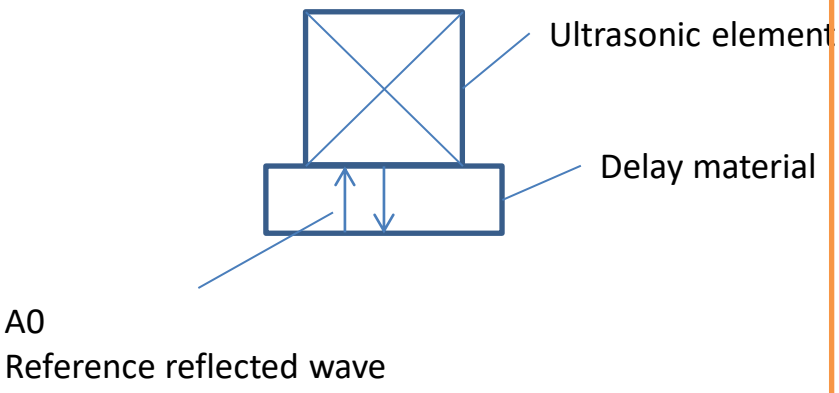
By amino, iwai, uchiyama

Measurement example of the highfrequency viscoelasticity of various materials

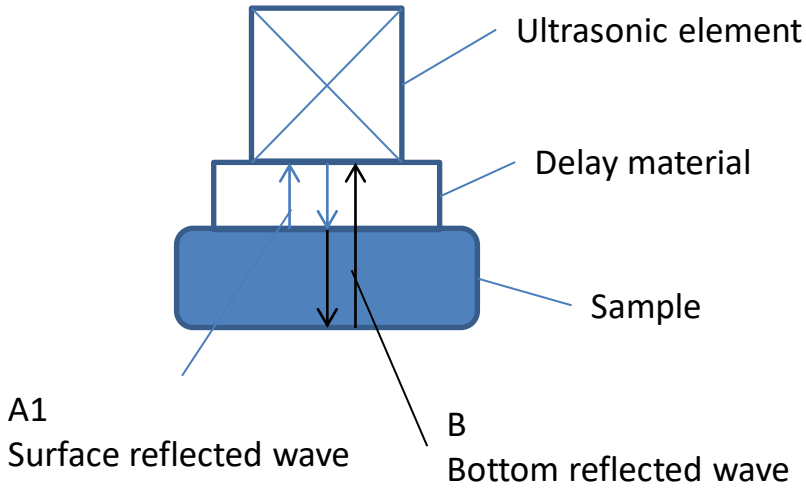


Waveform collection configuration

①You can absolute value measured by the reference waveform A0.
②And calculates the viscoelasticity by the surface reflected wave A1 and the bottom surface reflected wave B.
(Bottom method)
③It is also possible to calculate a viscoelastic alone the surface reflected wave A1.
(Surface method)



Reference waveform data collection



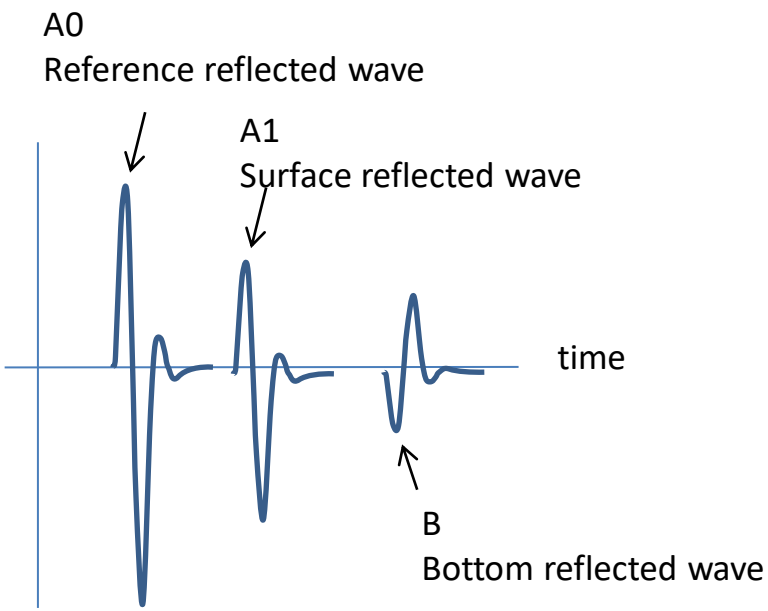
The measured waveform data collection

Viscoelastic spectrum formula

Each of the waveform FFT processing, acoustic properties (sound velocity Vp, the attenuation factor α, density ρ) by substituting the viscoelastic formula to calculate the complex modulus. (Bottom method)

$$L' = \rho V_p{}^2, \quad L'' = \frac{2\alpha\rho V_p{}^3}{\omega} = \frac{2\alpha V_p}{\omega} L'$$

$$\tan\delta = \frac{L''}{L'} = \frac{2\alpha V_p}{\omega}$$



Longitudinal waves elastic modulus	L=K+4G/3
Bulk modulus	K=L−4G/3
Young's modulus	E=9KG/(3K+G)
Shear modulus	G=3KE/(9K−E)
Poisson's ratio	ν =(3K−2G)/2(3K+G)

HFR002 high frequency viscoelasticity evaluation apparatus

Standard specifications

・Measurement frequency: 0.5 to 20MHz
* Multiple sensors are required. The measurement band varies depending on the measurement sample.
-Sample: Solid, suspension, liquid (each has a separate attachment)

・Sample size: Flat size 50x50 mm or more
Approximately 1 to 10 mm thick (varies depending on the measurement sample and measurement band)
• For solids, parallelism and thickness accuracy affect measurement accuracy, so please contact us.

・Solid measurement unit size WDH: 250X200X400mm
・HFR002 controller size WDH: 450X650X700mm

* A constant temperature bath is required for high-precision measurement.
(Inner dimensions WDH: 360x250x420mm or more)

・Weight: 65kg
・Power supply: 100V 1000w Class D grounding

Equipment full view

Development, manufacturing and sales **HFVE**

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Since the specifications are subject to revision without notice for improvement,
Please contact me at the time of use . 2024.01.19