Measurement Equipment

Measuring Properties of an object with Acoustically Induced Electromagnetic Waves(ASEM)

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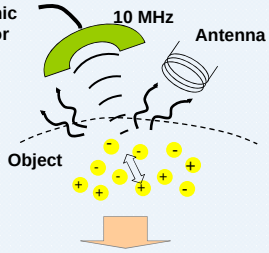
1. Novel ASEM method

- Conventional:
  (Ultrasonic-pulse echo method)
  Mechanical Properties { Mass density distribution / Elastic coefficient }

Echo method

Imaging of mechanical properties

- Novel : ASEM
  Acoustically Stimulated ElectroMagnetic Method



Imaging of Electromagnetic Properties
(developed by K. Ikushima)

Electromagnetic radiation is generated by temporal modulation of the magnetization or electric polarization via ultrasonic waves in a variety of materials.

Ultrasonic wave → Tm → Bj

$$S_m = s_{mn} T_n + d_{jm} H_j,$$

Sm: Strain
Tn : Stress

$$B_j = d_{jm} T_m + \mu_{ji} H_j,$$

Assume, $m(t) = m_0 \sin \omega t$

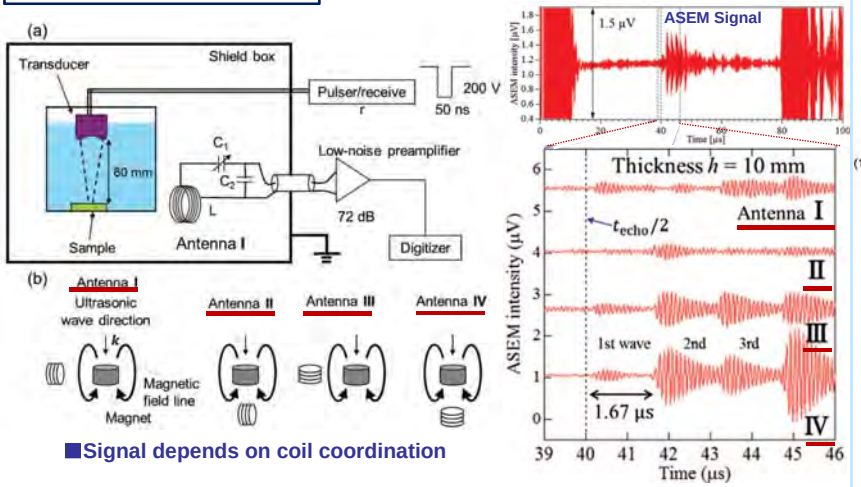
$$B_{\text{emit}}^{\text{near}}(x,t) = -\frac{\mu_0}{4\pi}\{3(m_0 \cdot n_0)n_0 - m_0\} \times \frac{\sin \omega t}{r^3}.$$

We observe V_{sig} ,

$$V_{\text{sig}} \propto \{3(m_0 \cdot n_0)n_0 - m_0)\omega \cos \omega t\}/r^3.$$

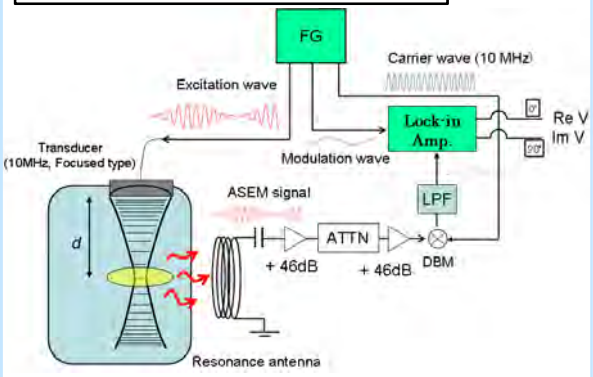
2. Measurement & Data

(1) Pulse – ASEM Method



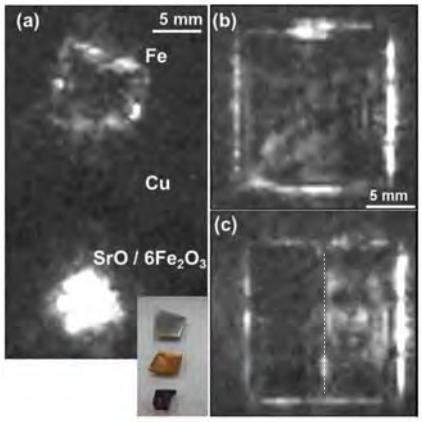
■Signal depends on coil coordination

(2) AM Modulation – ASEM Method



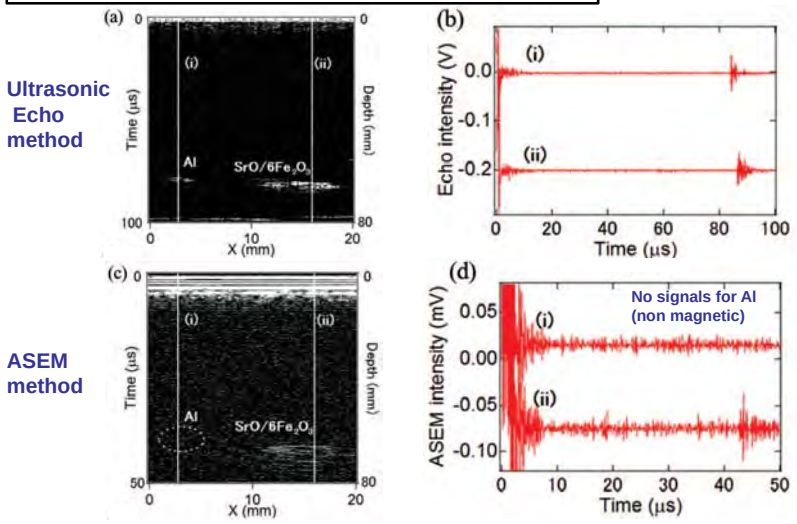
Improvement:
■Large S/N ratio
■Shorter measurement time

(a) Non destructive 2-D Magnetic Image



ASEM images for magnetic(Fe and SrO/6Fe_2O_3) and nonmagnetic materials(Cu). Visualization of the stress induced magnetization in an iron foil before(b) and after folding. The new residual stress is observed through the ASEM signals(the white Line in (c)).

(b) Non destructive Magnetic Tomographic Image



"For magnetic materials, non destructive hysteresis measurement is also possible.

4. Application

- Imaging of materials which electromagnetically responds via the ultrasonic wave.
  (piezoelectric, magnetic materials which light doesn't penetrate)

Patent Licensing Available

Patent No.: WO2007/055057 (JP, US, EP)

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