Condition Monitoring and Displacement Control of Piezoelectric Actuator by Using Induced Charge

Background and problem

- Hysteresis of displacement to applied voltage in piezoelectric actuator

Solution

- Monitoring induced charge on electrodes attached at ends of piezoelectric actuator, which is proportional to displacement

Advantages

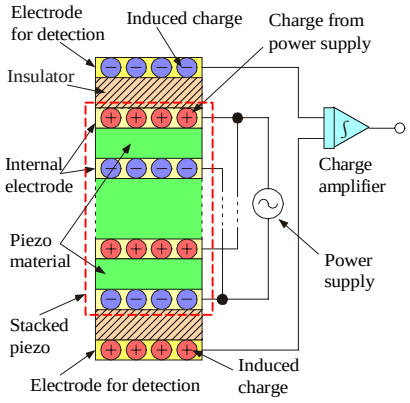
- Enable to use conventional power supply
- Unnecessary high voltage supply
- Small size because of simple structure

Results

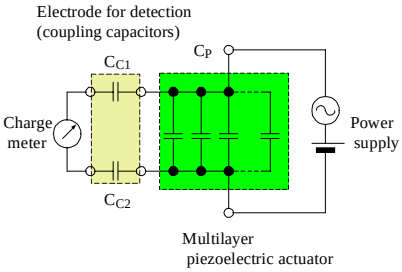
- Constant ratio of displacement to induced charge regardless of bias voltage and voltage amplitude
- Only 1 % hysteresis, which is 1/10
- Enable to control displacement for a long time by inverse transfer function compensation

Applicable fields

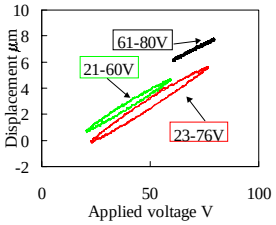
- Vibration control
- Ultraprecision positioning



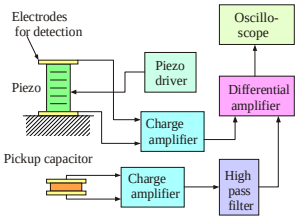
Measurement principle of displacement of stacked piezoelectric actuator by using induced charge



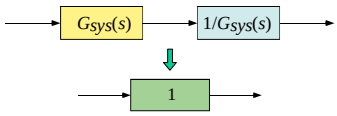
Equivalent circuit of piezoelectric actuator with electrodes for detection



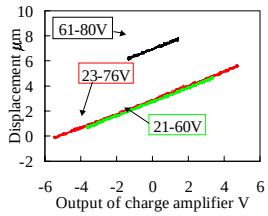
Examples of hysteresis loop



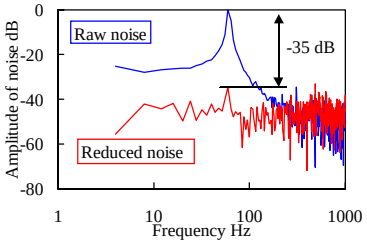
Noise reduction by differential method



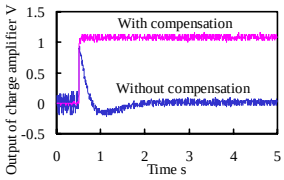
Principle of inverse transfer function compensation



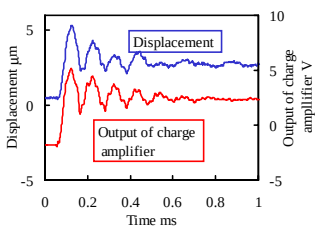
Relationship between displacement and induced charge



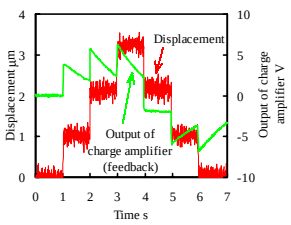
Result of noise reduction



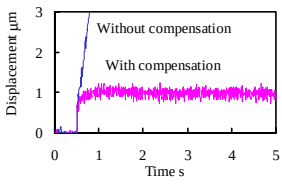
Output of charge amplifier



Comparison of Step response



Result of stair-like displacement control



Displacement of Piezoelectric actuator

URL: http://www.toyota-ti.ac.jp/Lab/Kikai/5k60/

12-1, Hisakata 2-chome, Tempaku-ku, Nagoya 468-8511 JAPAN