Cu-Alloying Effect on Structure Stability of Au Micro-Cantilever Evaluated by Long-Term Vibration Test

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Introduction

- Au materials:
  - High density
  - High electrical conductivity
  - High corrosion resistance

- Applications in MEMS Devices:
  - Au-based MEMS acceleration sensor can detect Sub-1µG
  - Concerns about reliability and lifetime due to gold’s weak mechanical property

Solutions by Au-Cu alloy plating

- Solid solution strengthening
- Grain boundary strengthening

- The yield strength was improved from 0.22 GPa to 1.1 GPa [2]

Objective

- Evaluate long-term structure stability of the electrodeposited Au-Cu alloy

Experimental

- Au-Cu Alloy Micro-Cantilever
  - Length (l): 500, 1000 µm
  - Width (w): 10 ~ 20 µm
  - Ti thickness: 0.1 µm

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- Controller
- Vibration exciter

- Acceleration: 1.0 G
- Frequency: 10.0 Hz
- Cycle: up to 10^7

Results & Discussion

OM Image and height profile after vibration fatigue test

- No cracks and defects
- Remains straight
- Hardly changed

Structure stability after vibration fatigue test

- Alloying with Cu
- Small Δhtip

- Wide width
- Small Δhtip

Conclusions

- There were no cracks and defects in the cantilever beam after 10^3 ~ 10^7 cycles of vibration
- Structural stability was enhanced by alloying with Cu against vibration fatigue

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