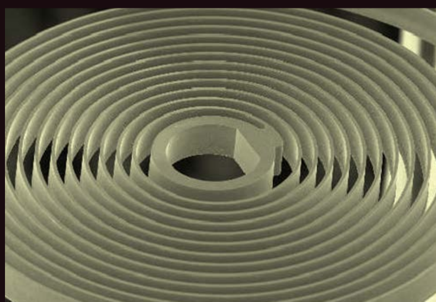
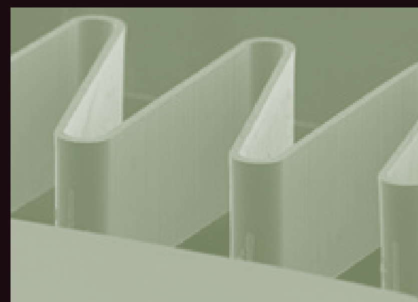
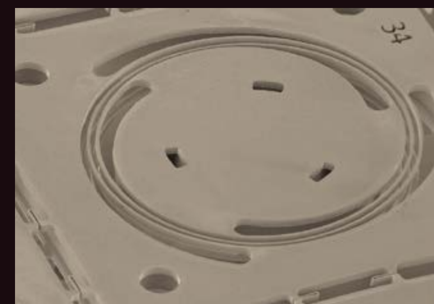
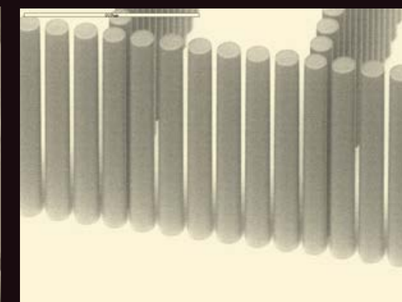
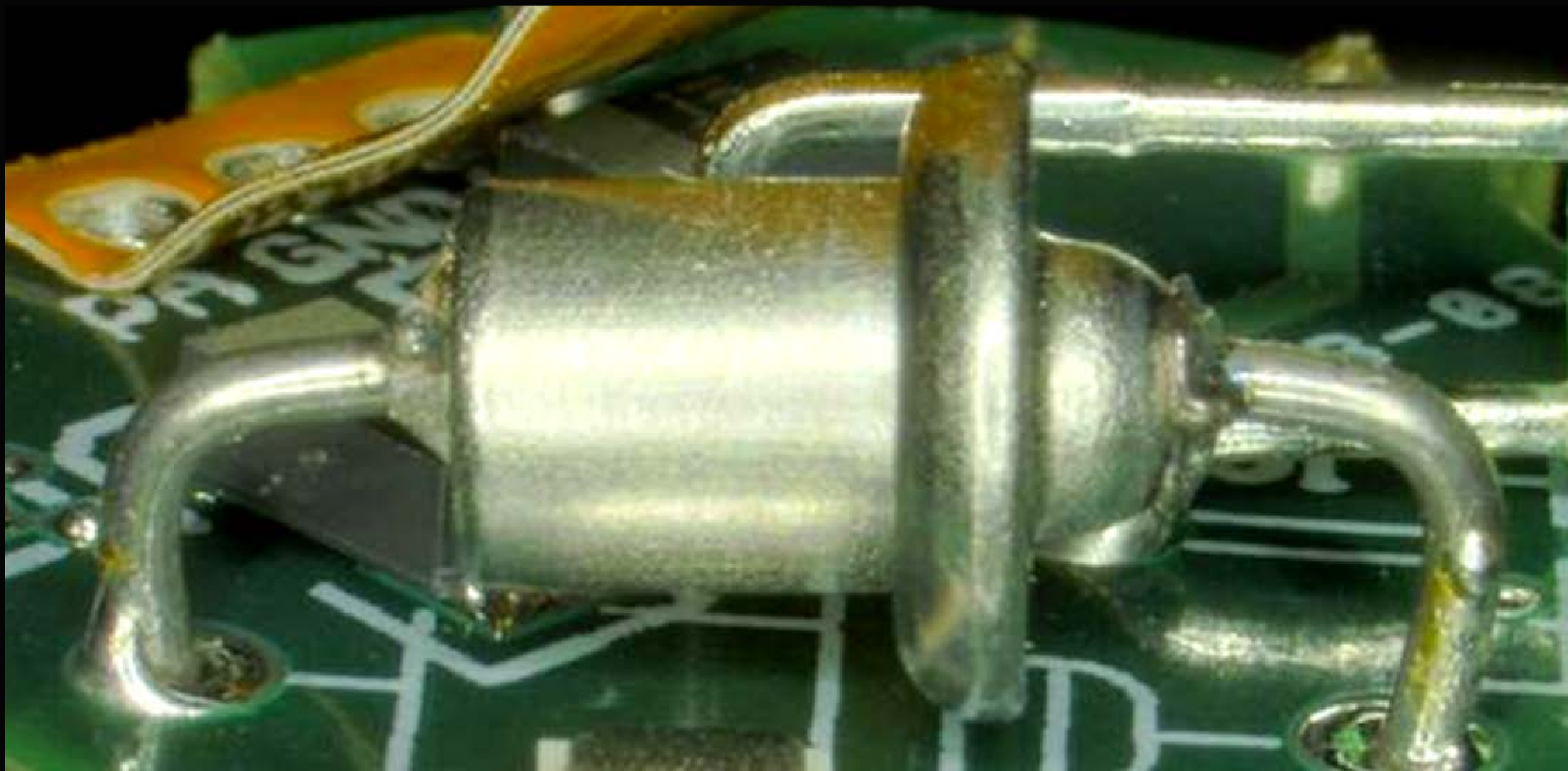
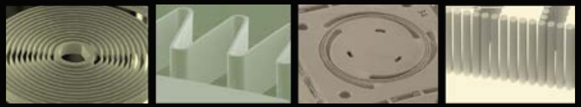





Low G MEMS Inertia Switches for Fuzing Applications

HT MicroAnalytical, Inc.
Sam Rogers, Danny Czaja, Hopper Chu,
Todd Christenson, Chairman & CTO

todd.c@htmicro.com


GND



Issues

- Reliability
- Scaling

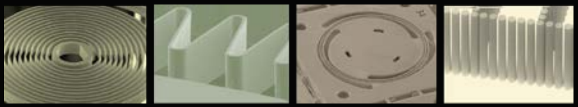
Approach

- Design
- Fabrication

Results

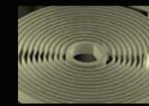
- Initial Testing

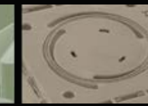
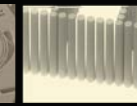
Reliability



- Reliability → Force → Δ Energy → Volume

Reliability



$$F_{ctct} = (ma - kx_{ctct})$$

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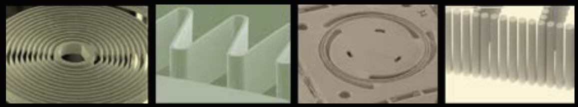
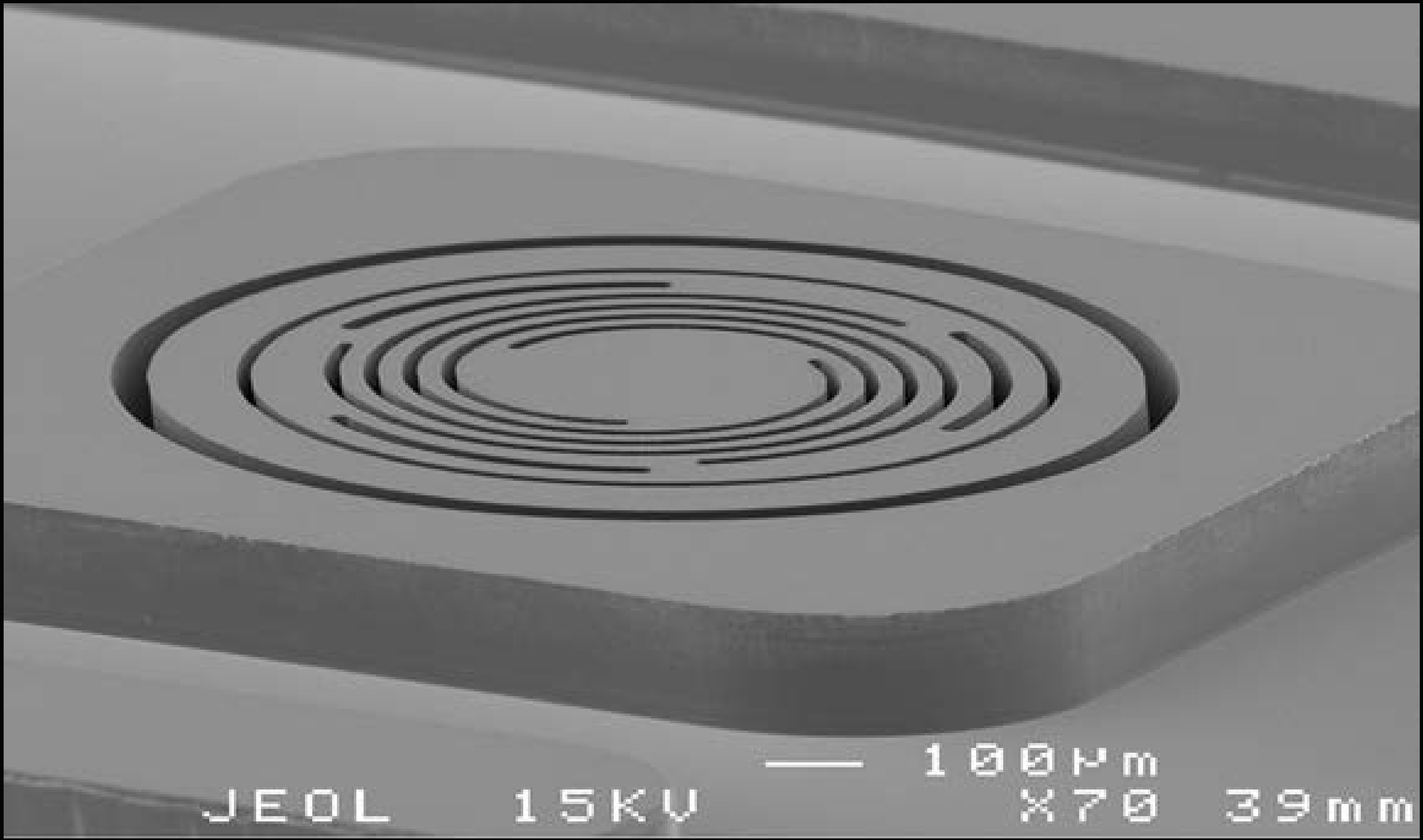
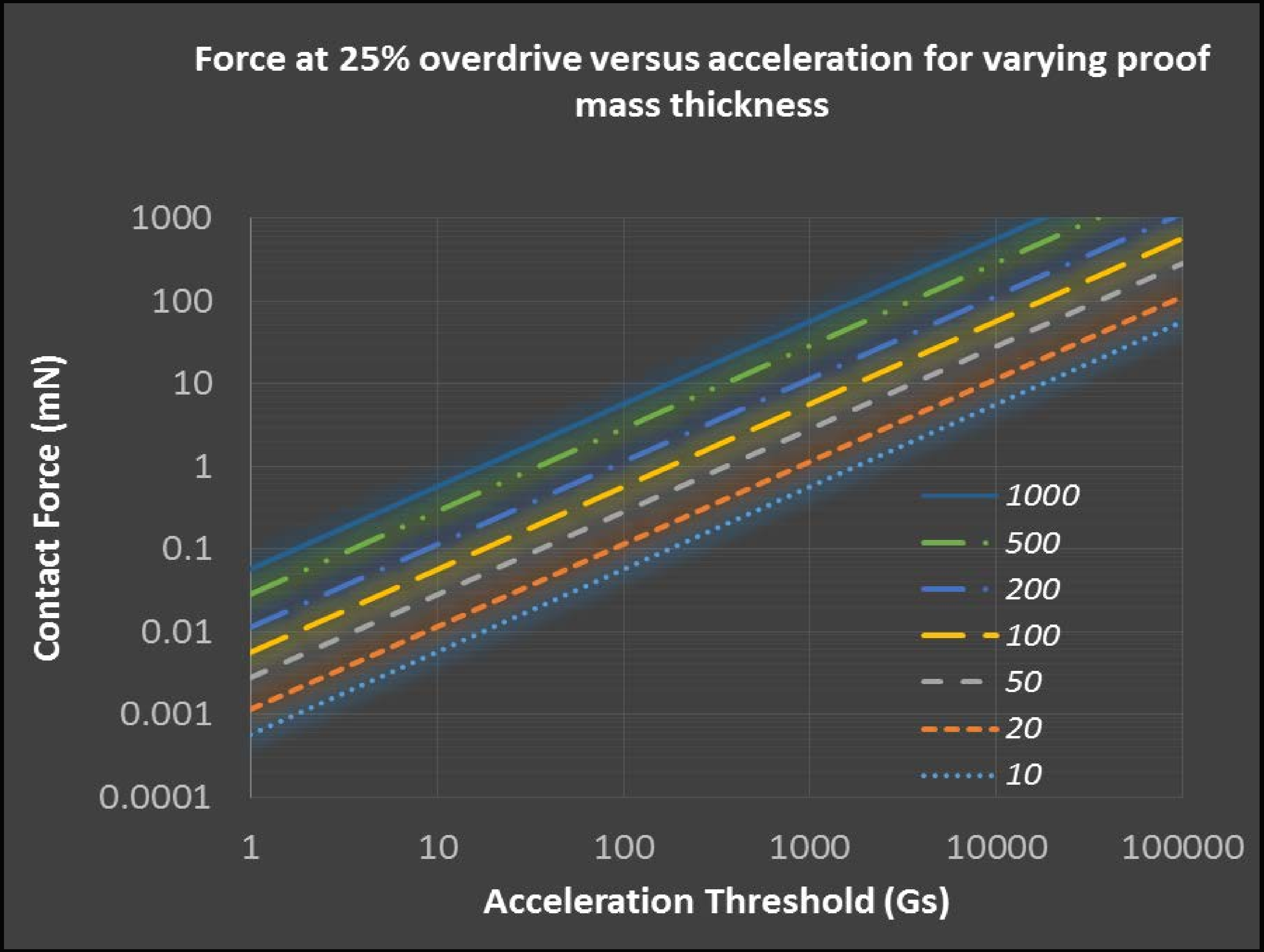
Design

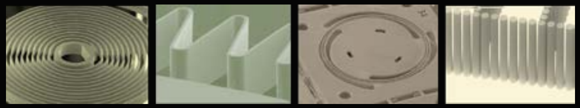


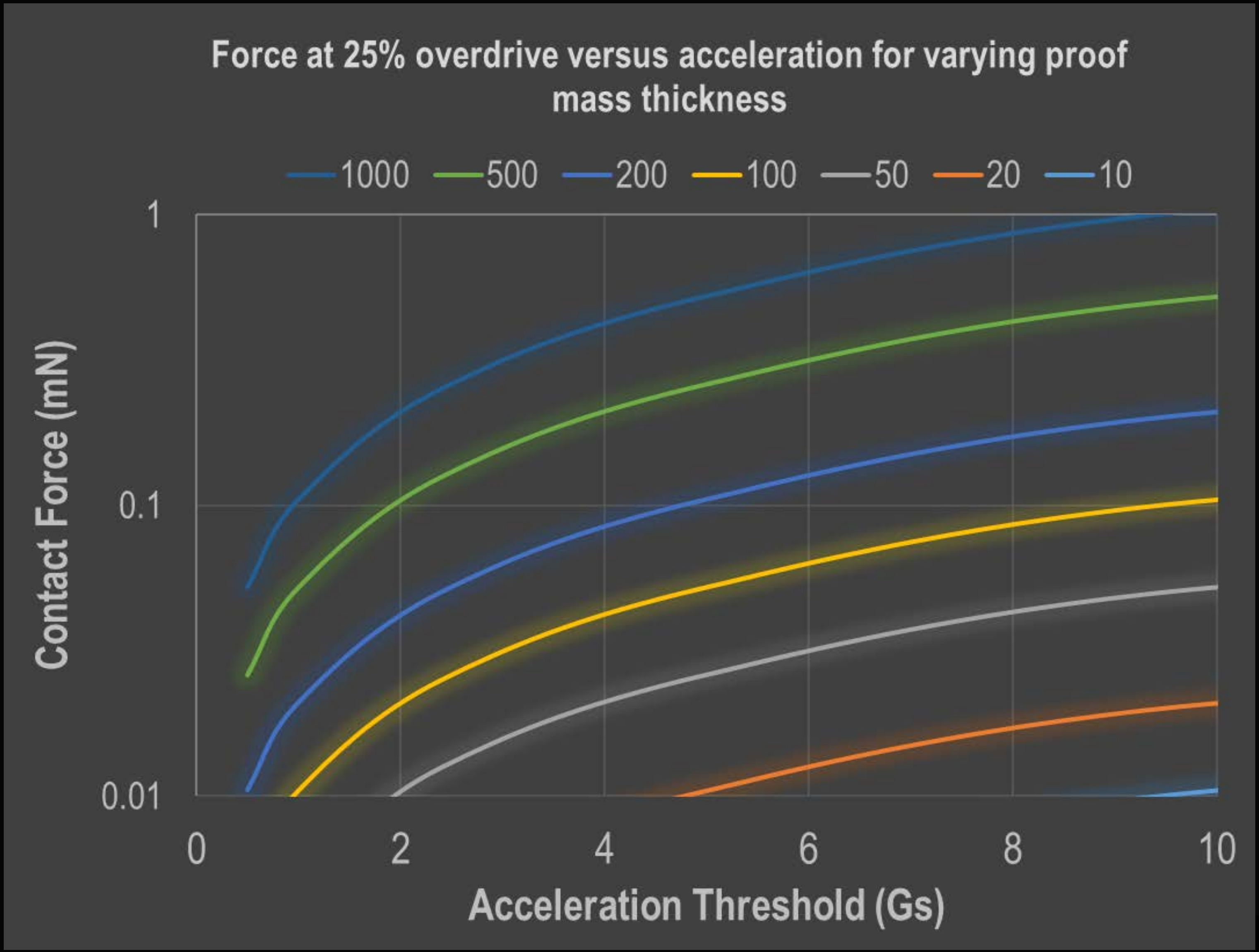


Reliability

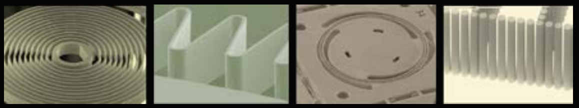


Design




Force at 25% overdrive versus acceleration for varying proof mass thickness
1000
500
200
100
50
20
10
1
0.1
0.01
Contact Force (mN)
0
2
4
6
8
10
Acceleration Threshold (Gs)

Design



$$FOM \sim \frac{F\eta}{\$A} \sim \frac{\rho h \eta}{\$}$$

Design

Keys for High FOM / Viable Microfabricated Component

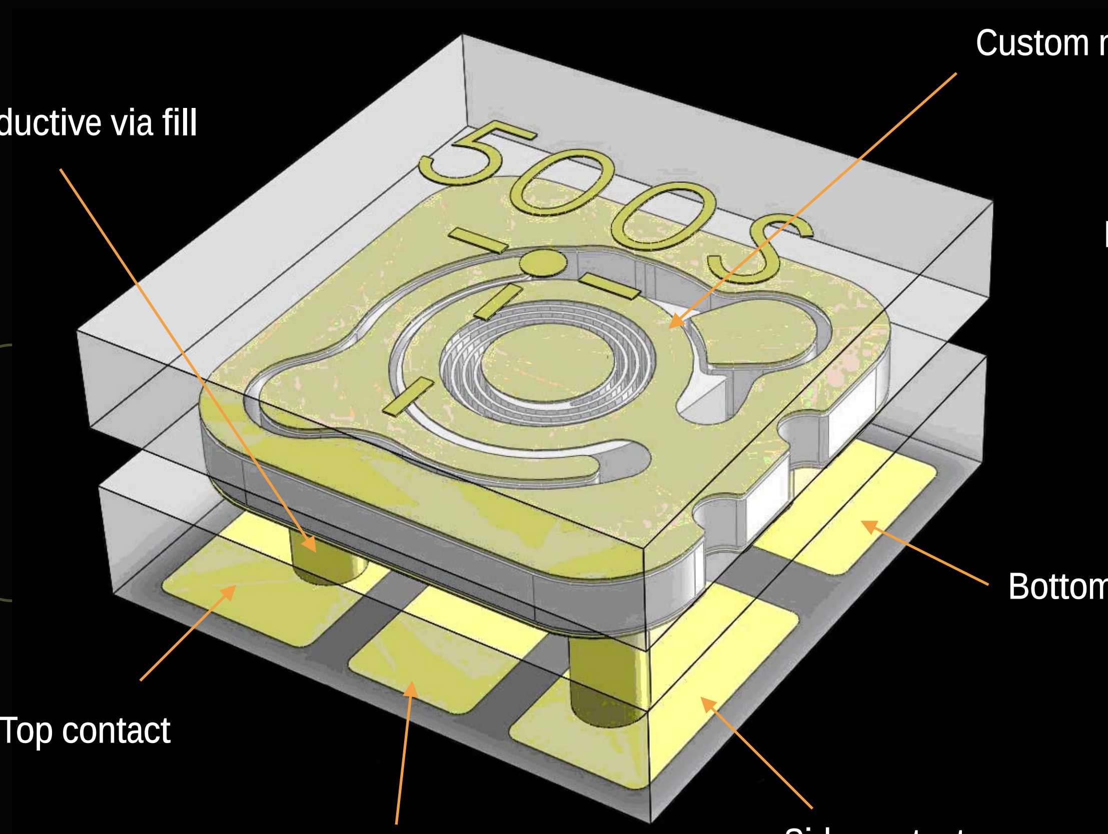
1) Materials – ρ, σ_y, σ-n - $

2) High Aspect Ratio - $

3) Tolerances / Integration / Packaging - $

4) Testing - $

Integrated Inertia Switch Anatomy



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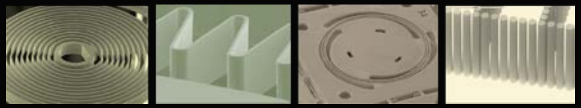
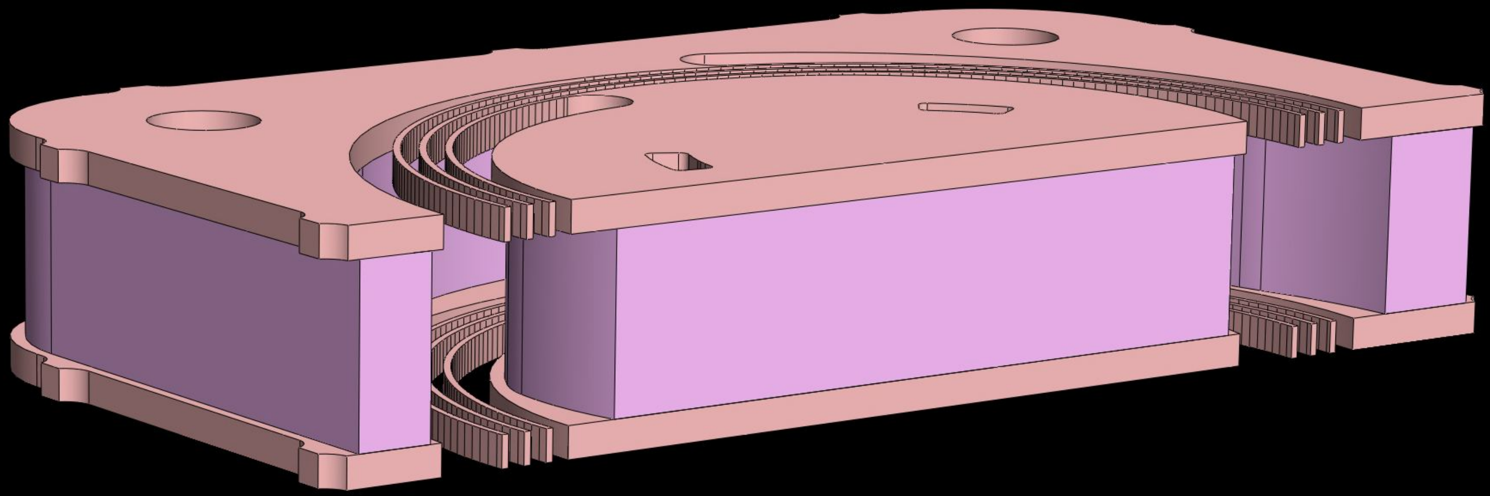
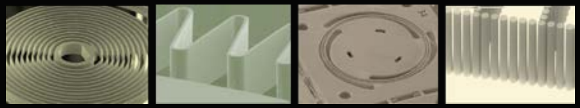
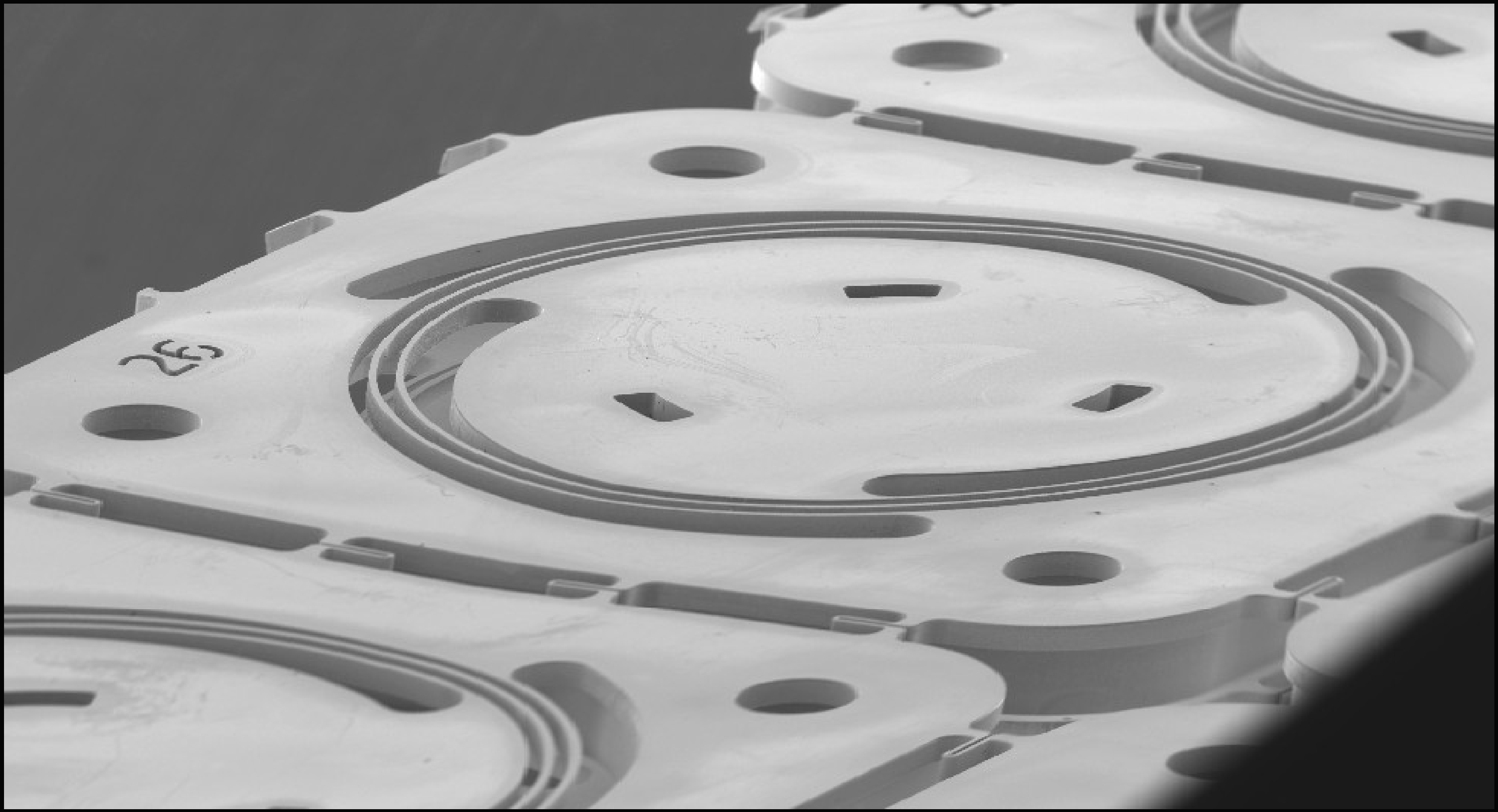
Multi-layer spring-mass fabrication



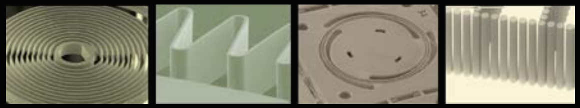


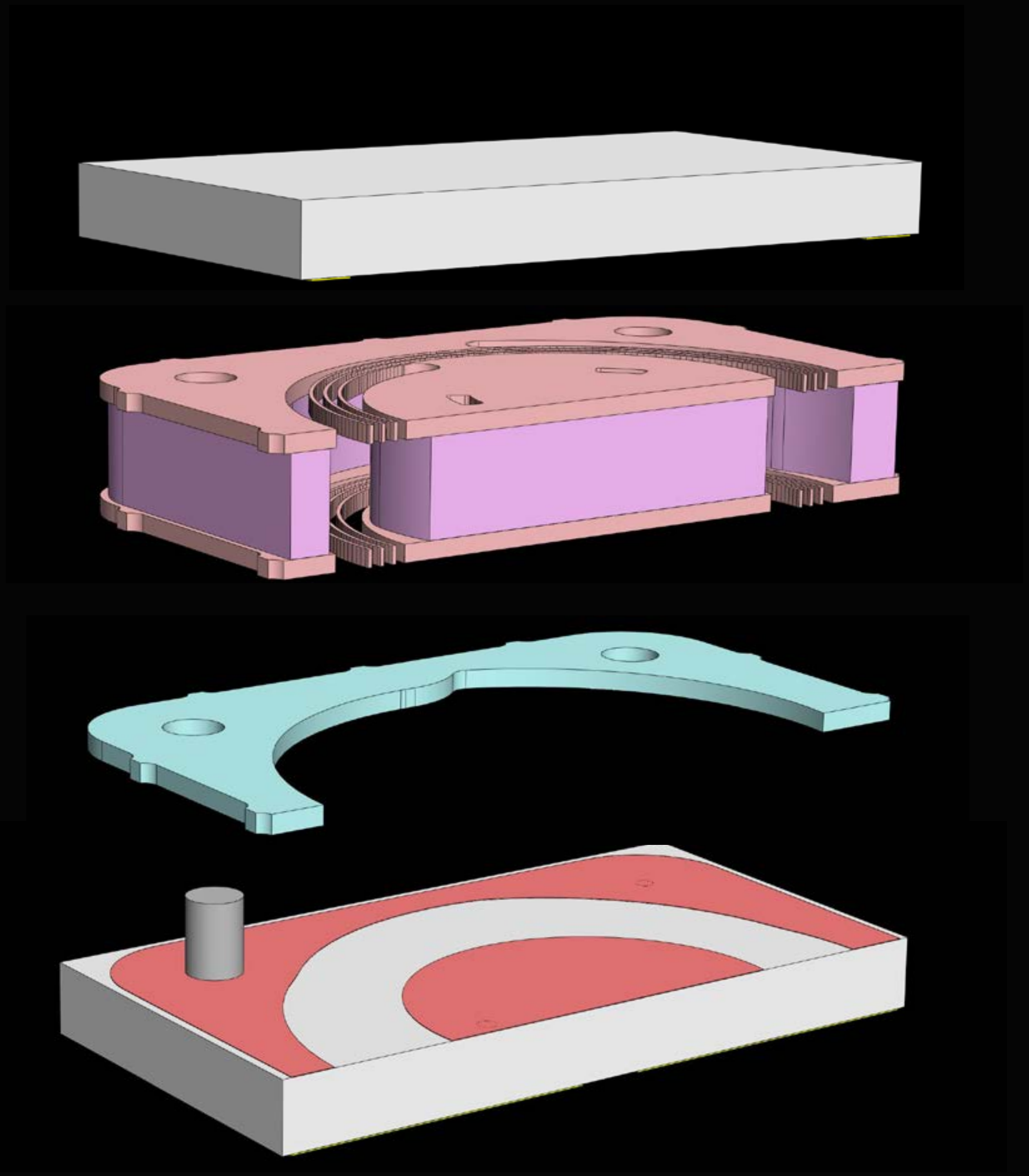
multi-layer fabrication



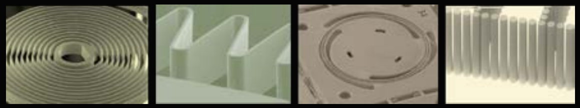


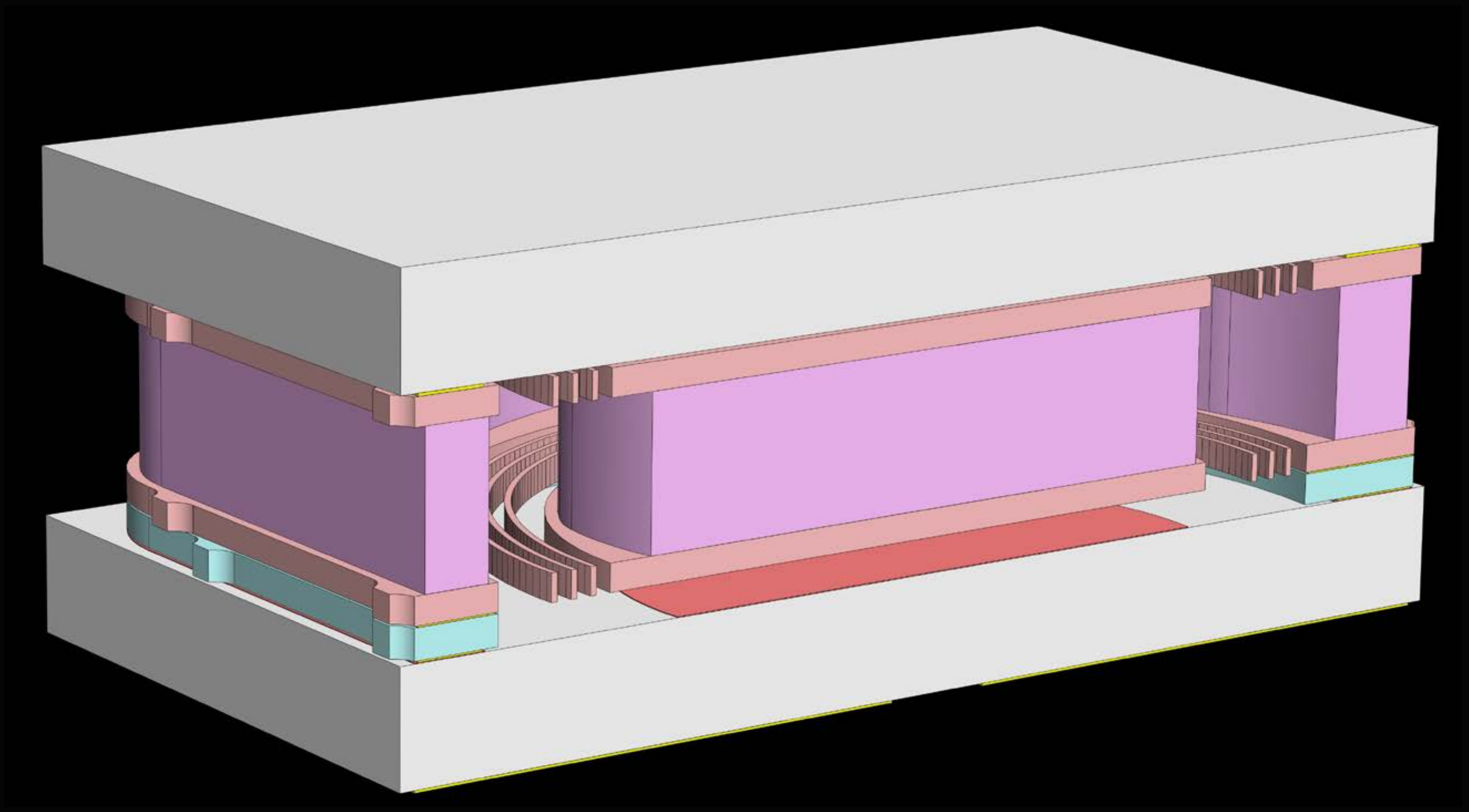
Multi-layer spring-mass fabrication



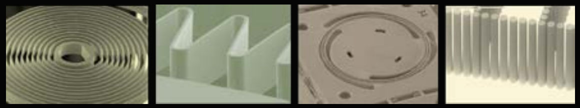


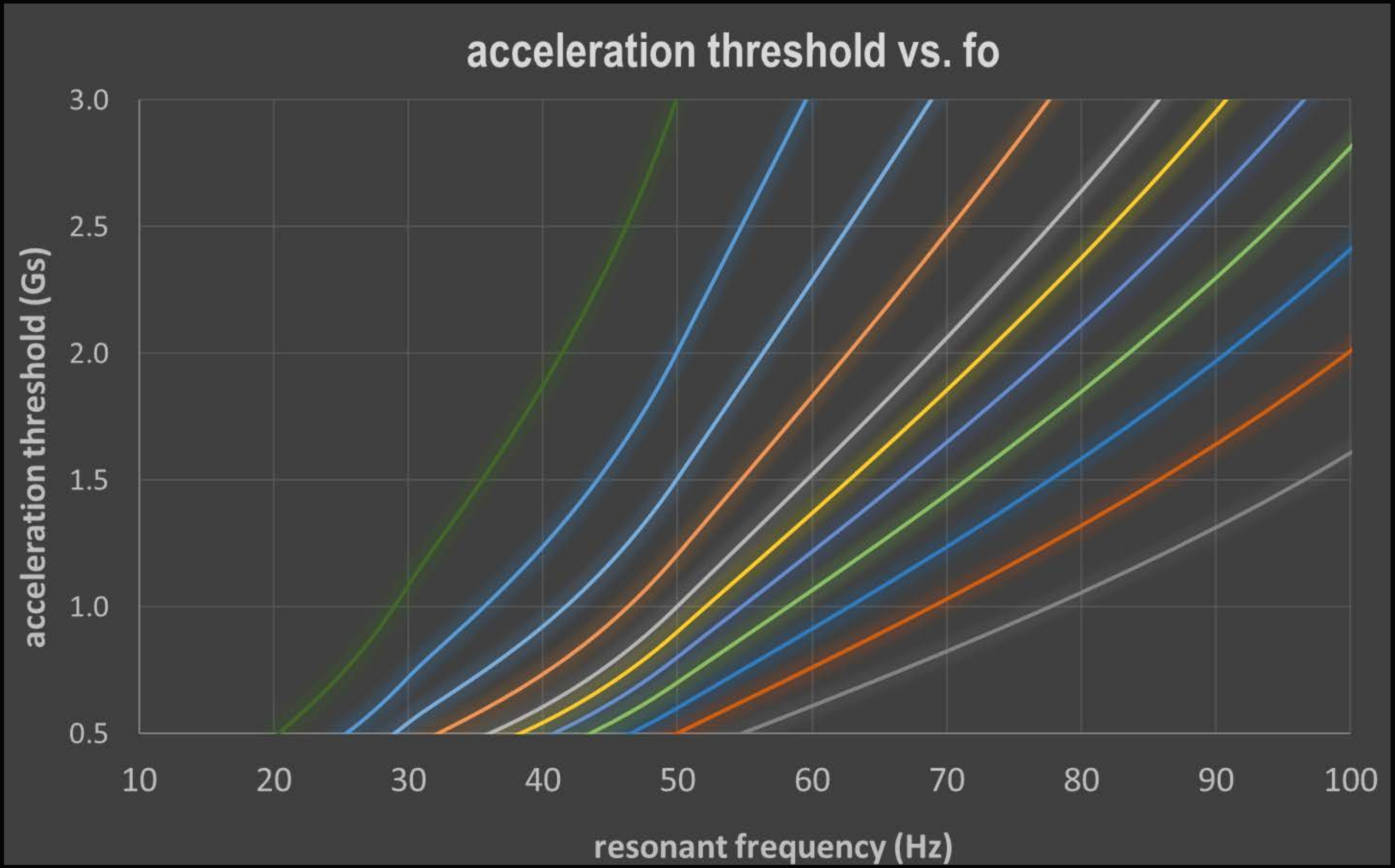
Multi-layer spring-mass fabrication





ma = kx





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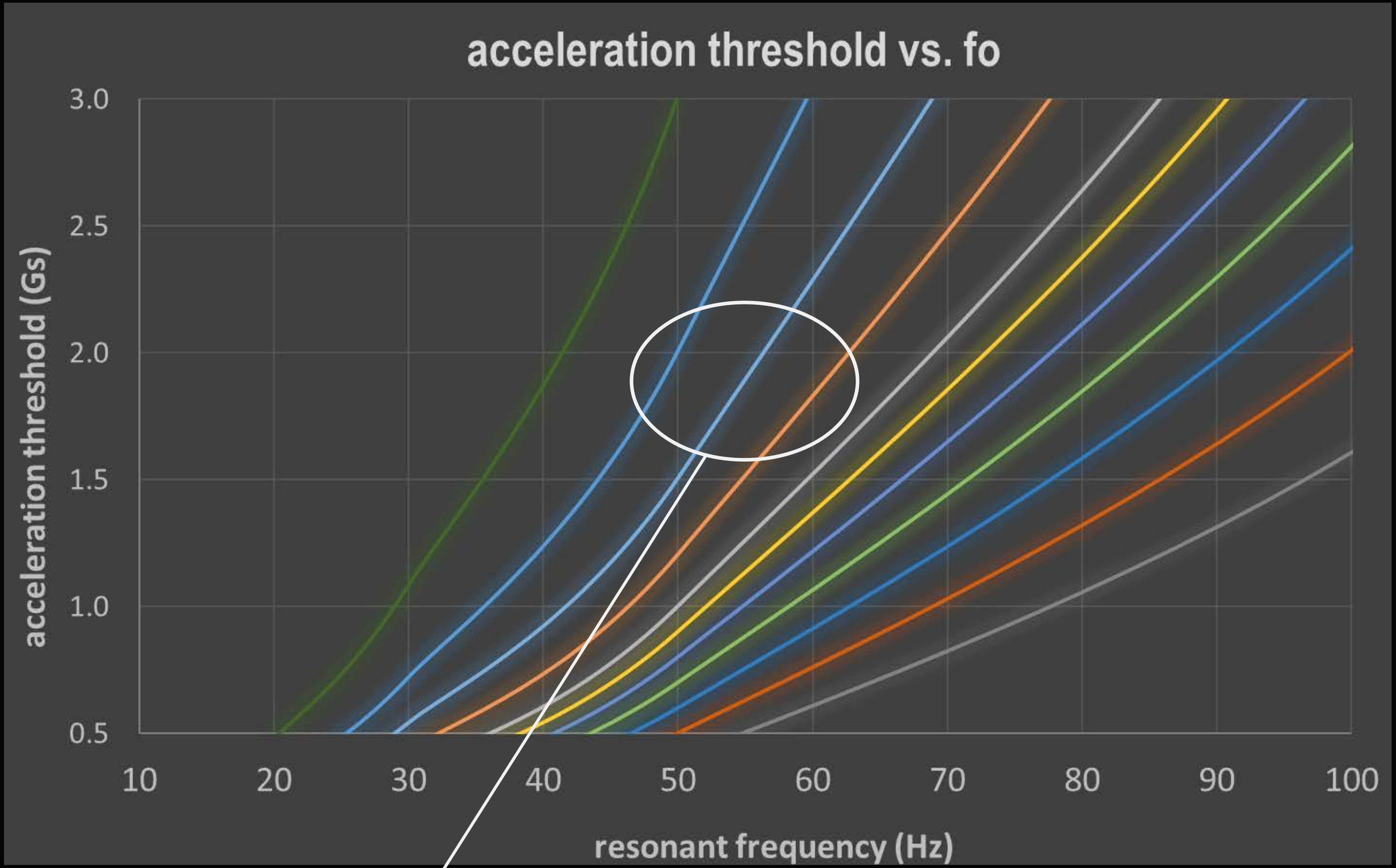
ma = kx



~ 0.05 G / Hz

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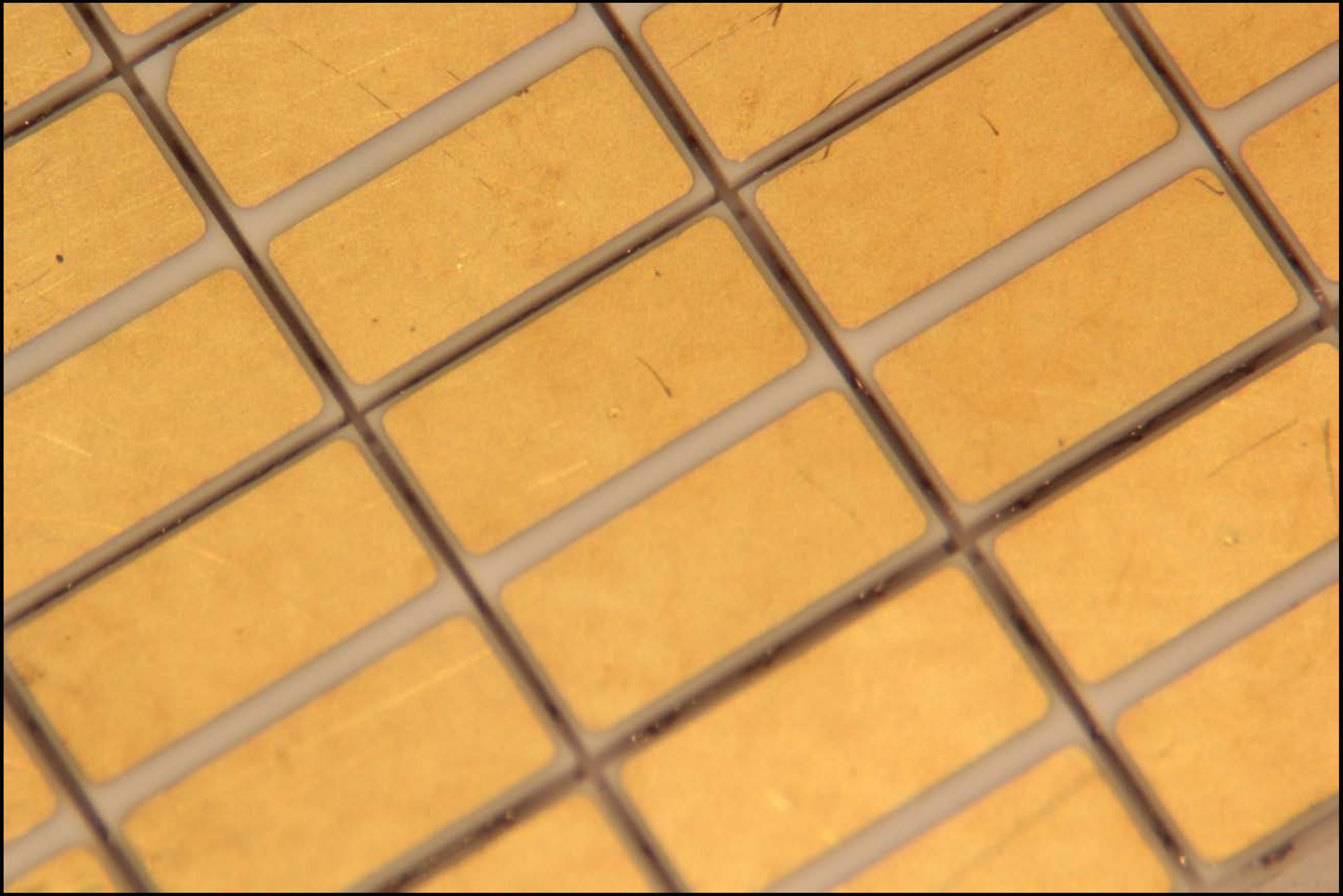
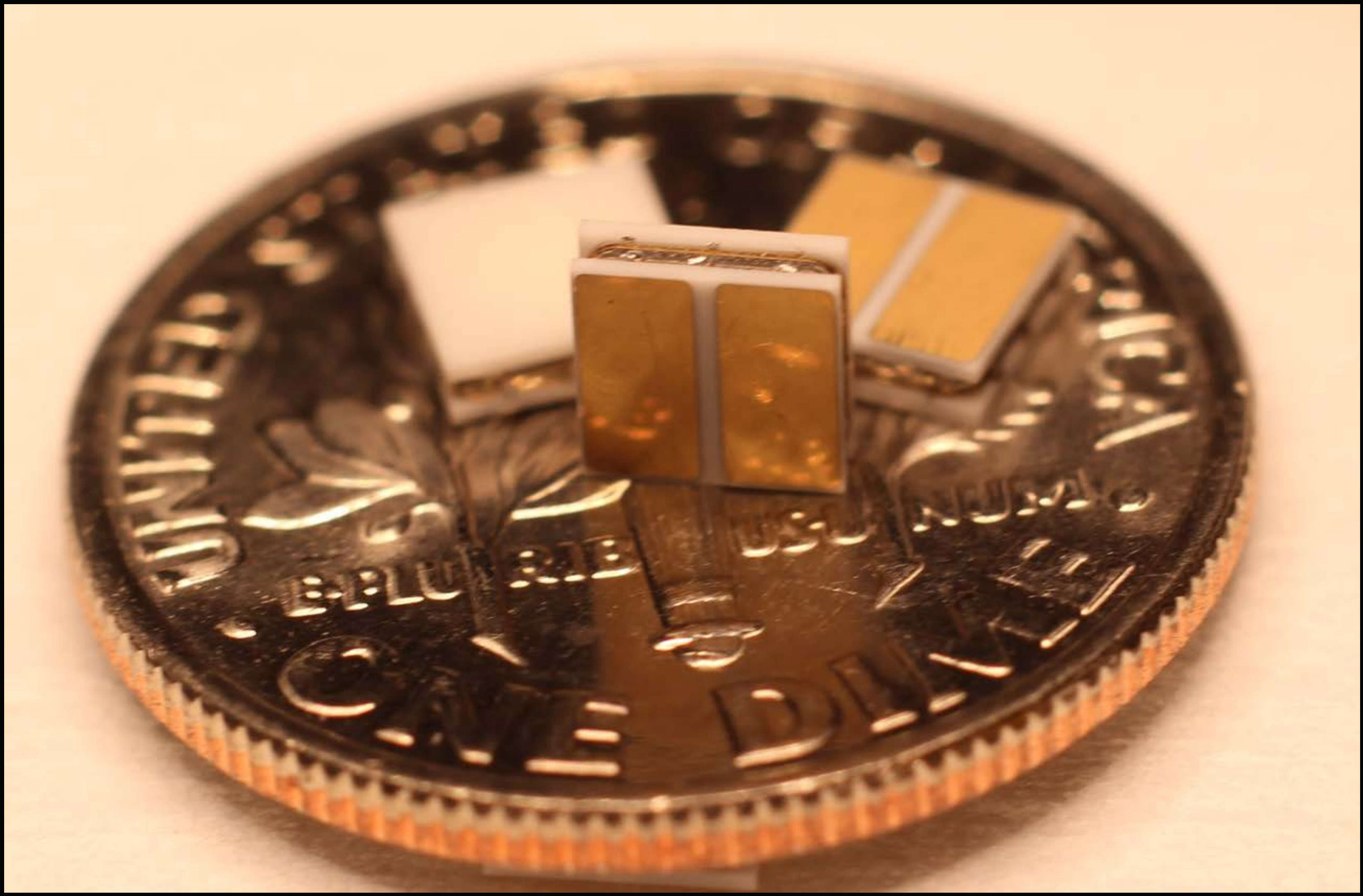
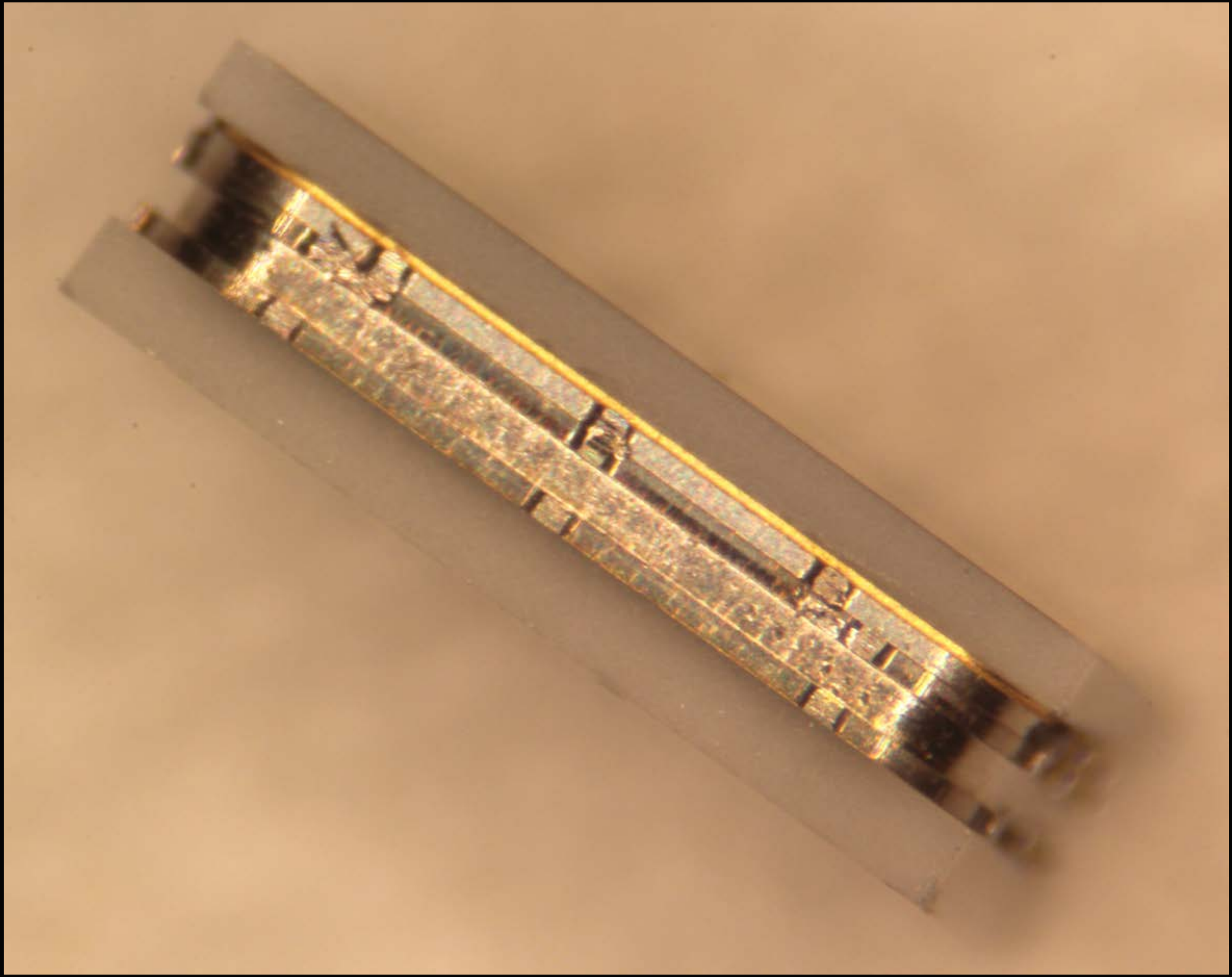
Diced Wafer



‘WLP’ Diced Parts



Edge of Device



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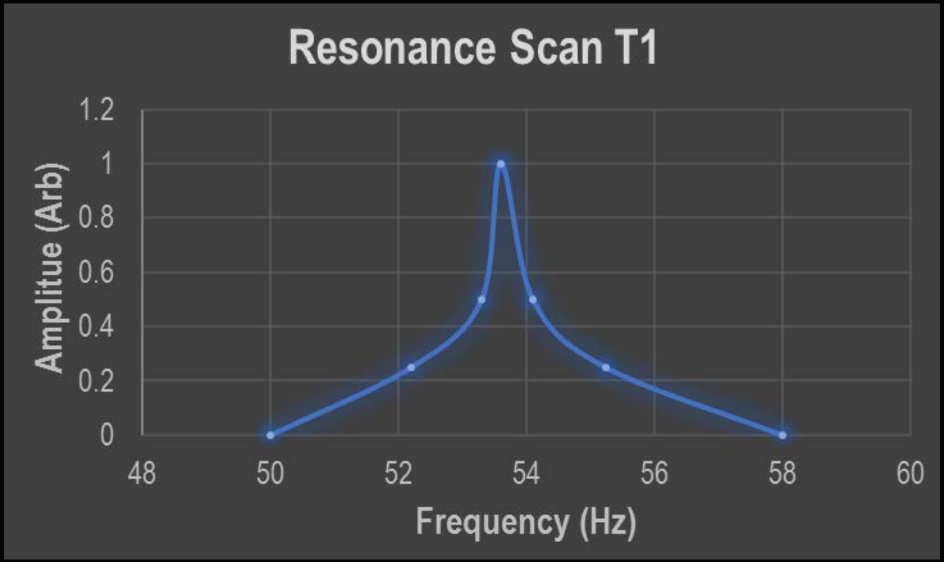
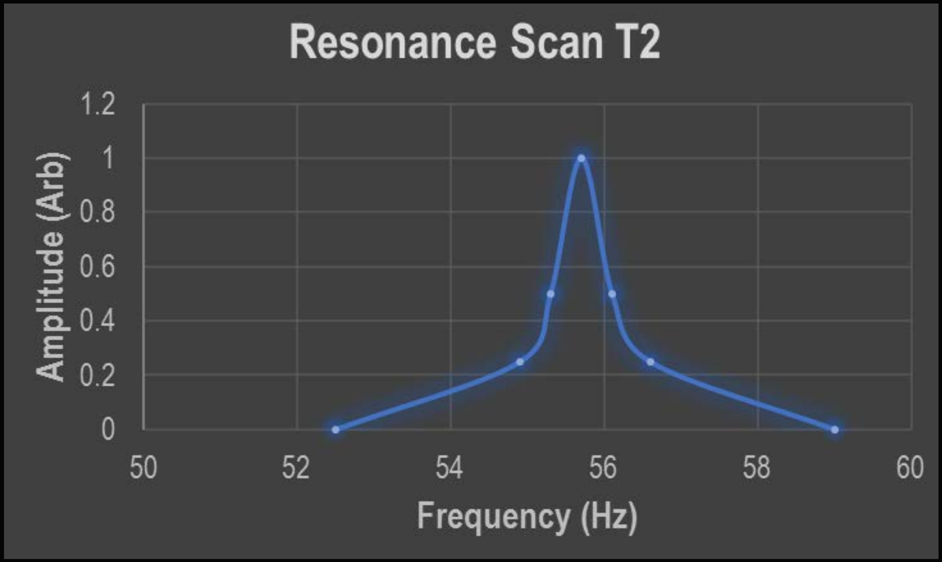
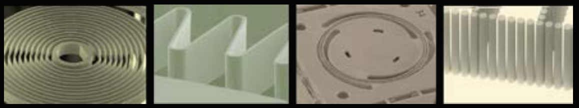
Resonance Measurements





Acknowledgements



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Daniel Jean (Indian Head)

Edward Cornell (China Lake)

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Thank You!

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