



Nanomechanical electro-optical modulator based on atomic heterostructures

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Overview



- Introduction to graphene-plasmonic hybrid modulation
- Integration of nanomechanical systems
- Results
- Conclusion



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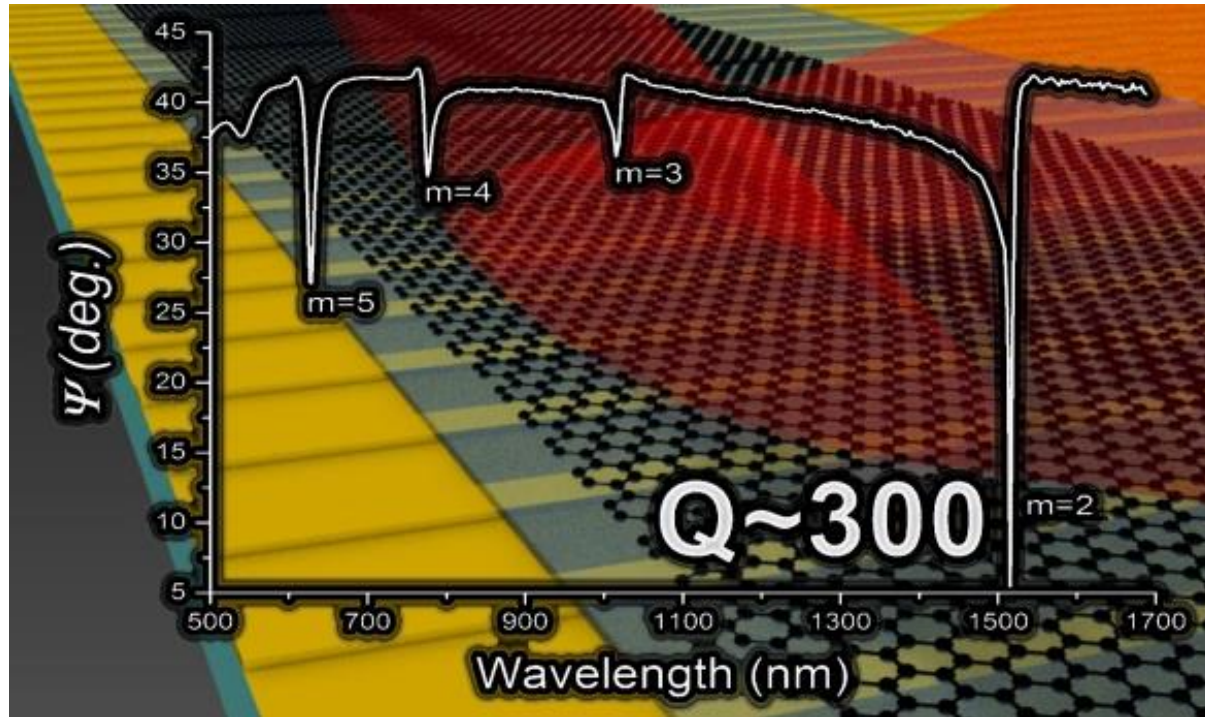
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Nanomechanical electro-optical modulator based on atomic heterostructures

P.A. Thomas¹, O.P. Marshall¹, F.J. Rodriguez¹, G.H. Auton², V.G. Kravets¹, D. Kundys¹, Y. Su¹ & A.N. Grigorenko¹

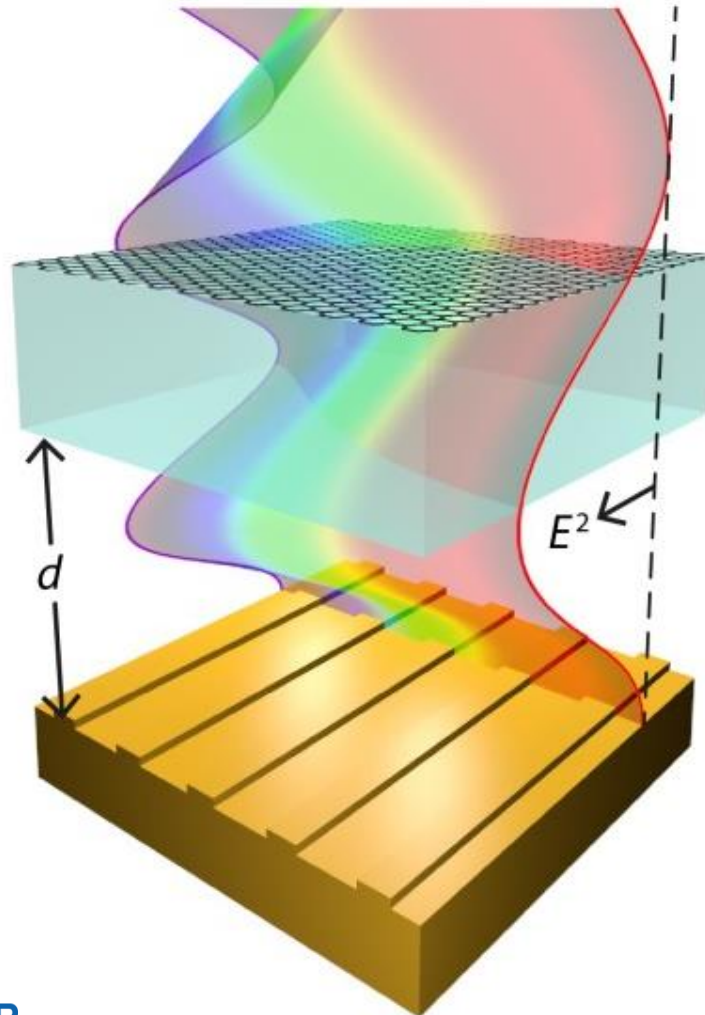
P. A. Thomas *et al.* *Nat Commun.* **7**:13590 (2016).

Hybrid graphene-plasmonic modulation

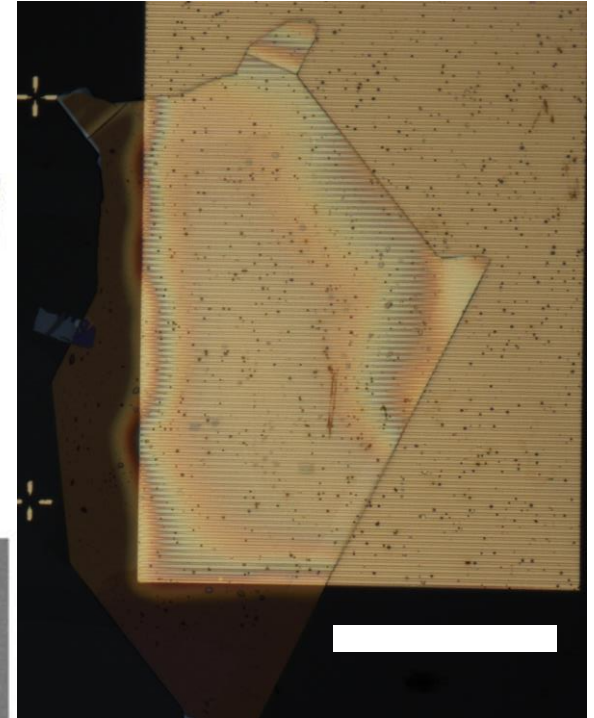
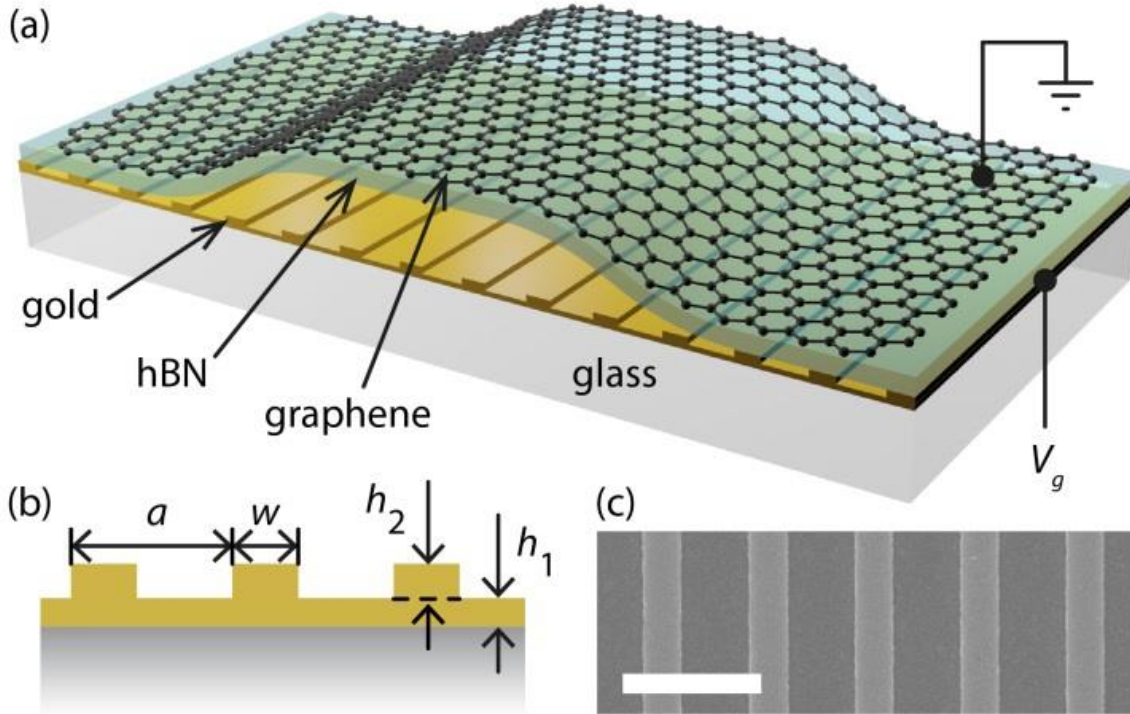


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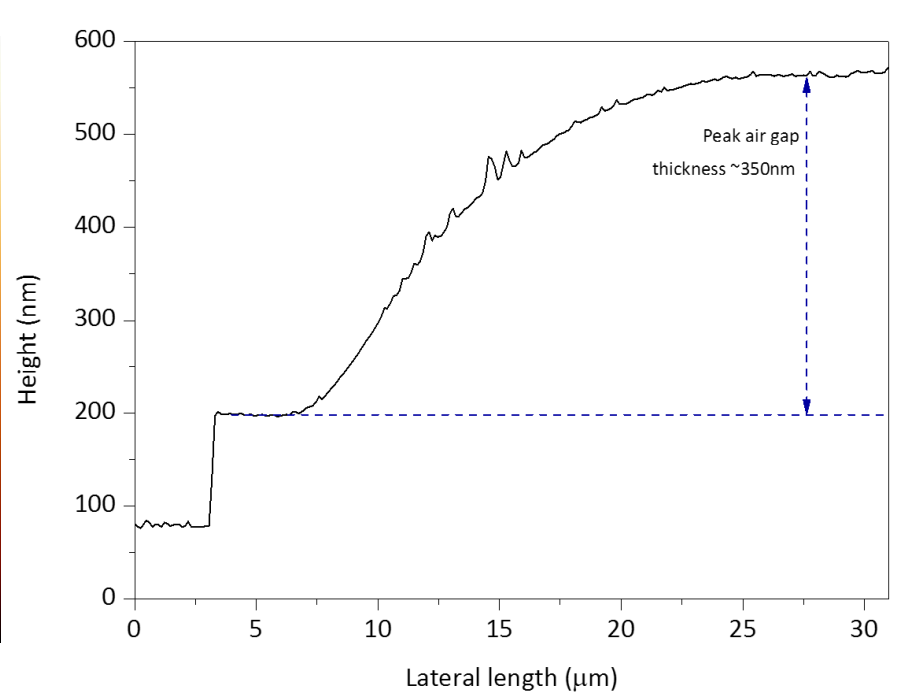
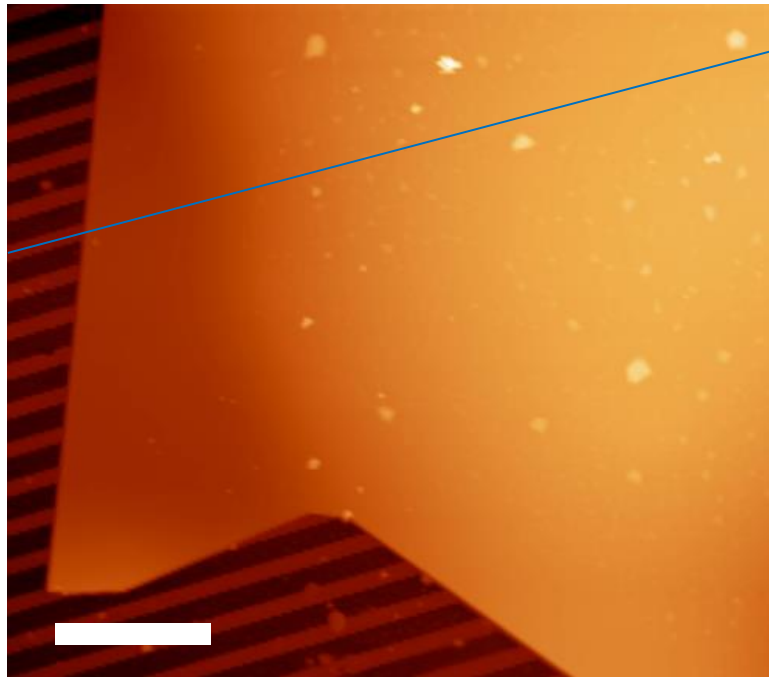
Mechanical electro-optical modulation



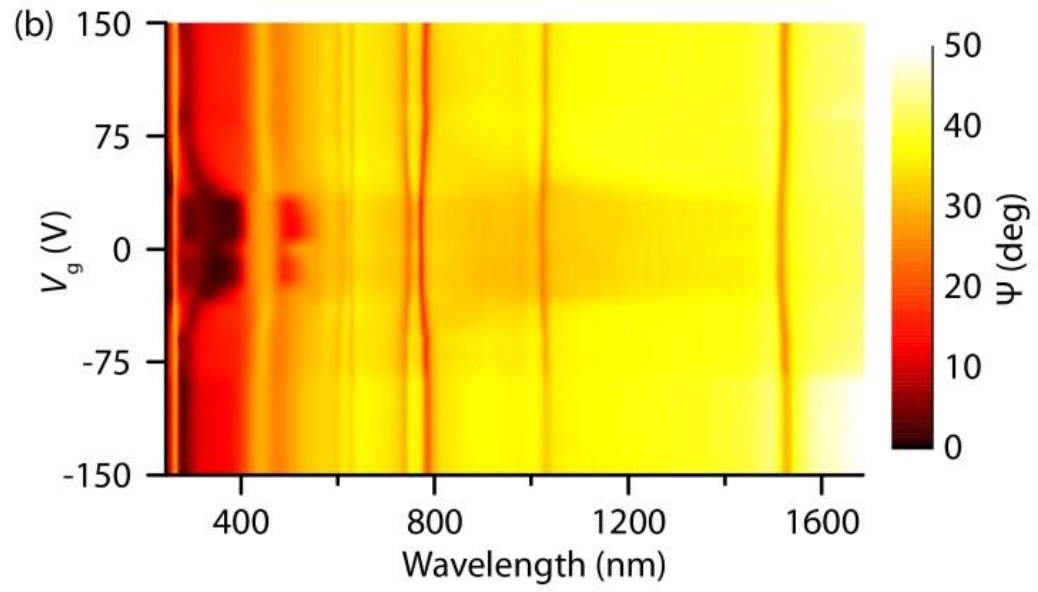
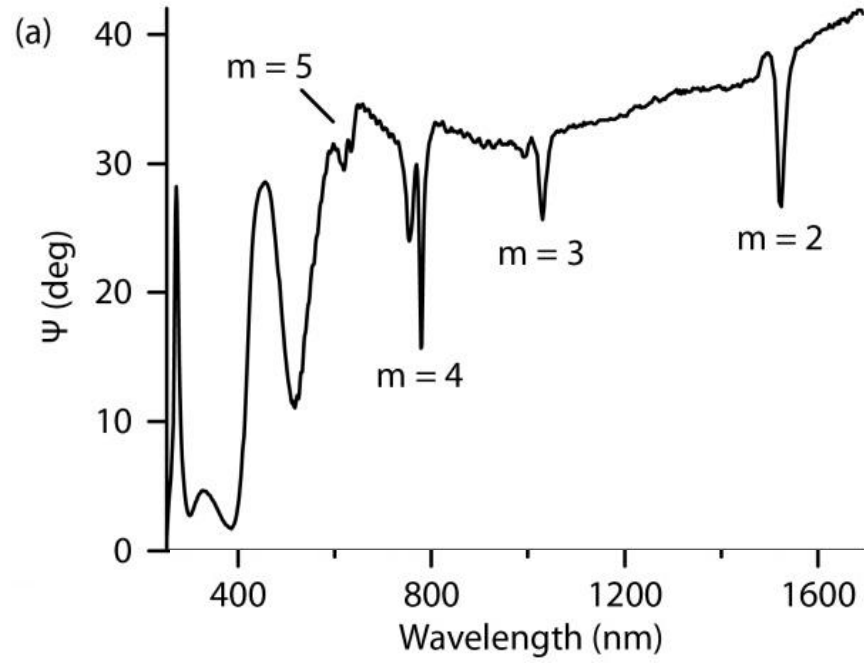
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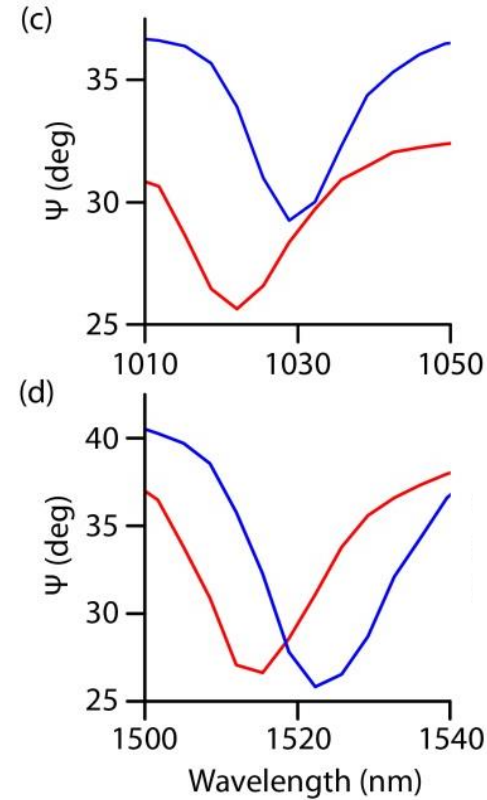
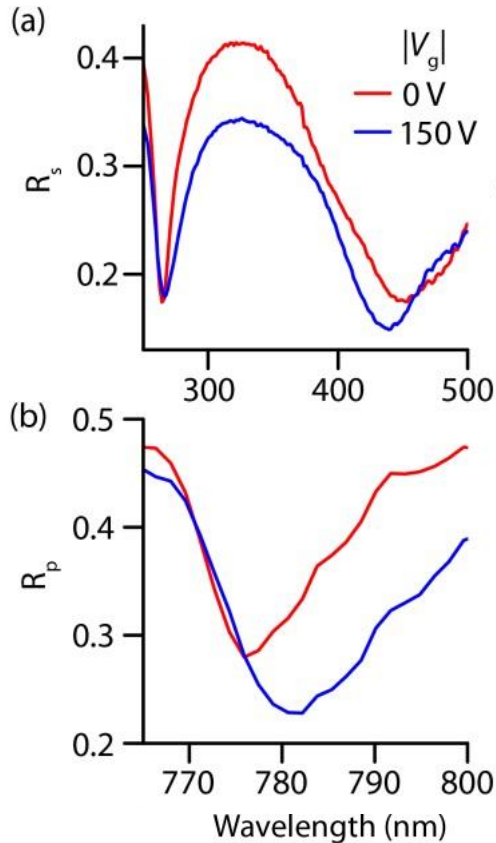
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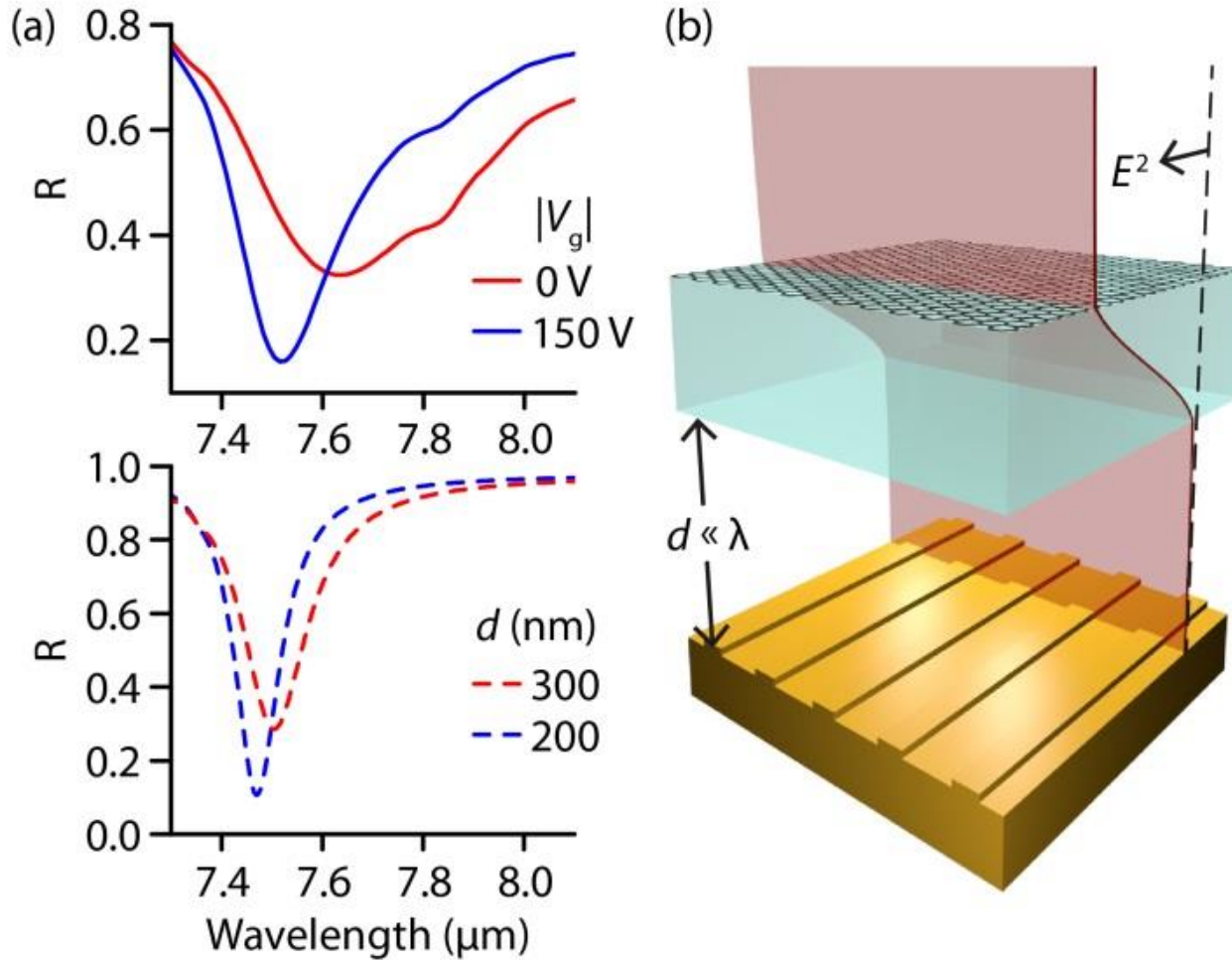
Broadband electro-optical modulation



Broadband electro-optical modulation



Compact electro-optical modulation



Conclusions



- Stronger, broader, customisable, compact modulation than previously reported using 2D materials
- Key step was introducing mechanical movement
- Room for even further optimisation

Acknowledgements



Sample fabrication:

- Vasyl Kravets
- Fran Rodriguez
- Gregory Hunter Auton

Modelling:

- Owen
- Sasha Grigorenko

Measurements:

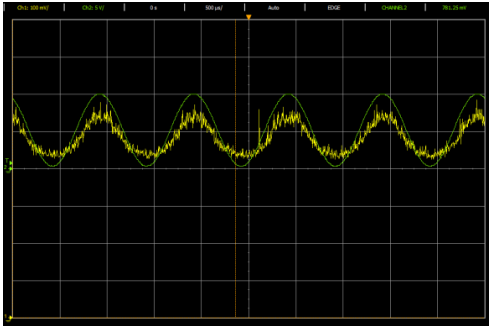
- Vasyl
- Owen Marshall
- Yang Su

Further reading:

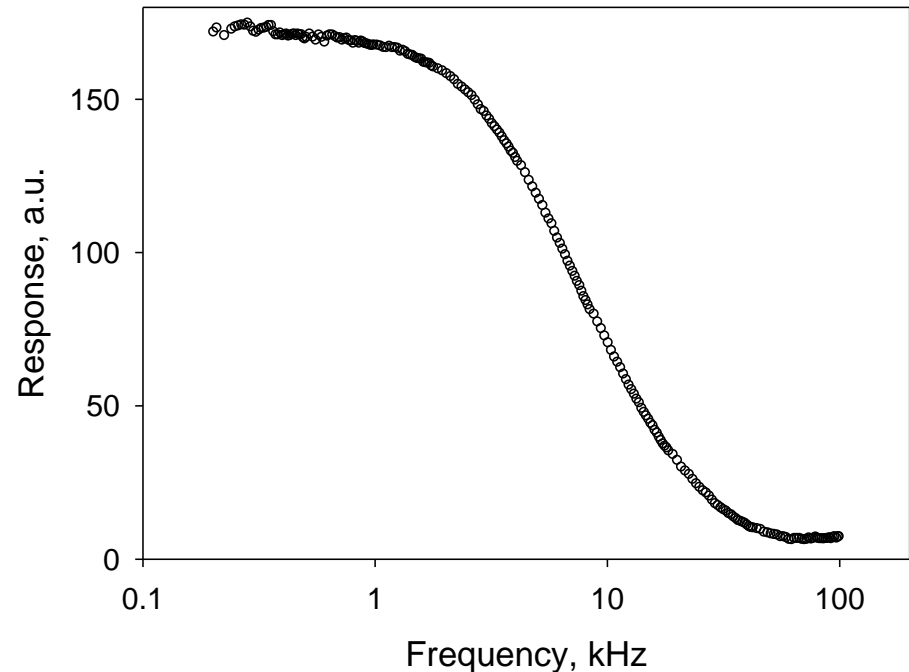
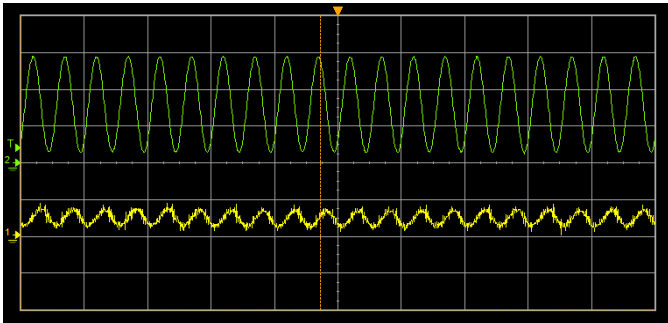
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Modulation frequency

1 kHz (including DC component)



4 MHz (AC coupling in oscilloscope)



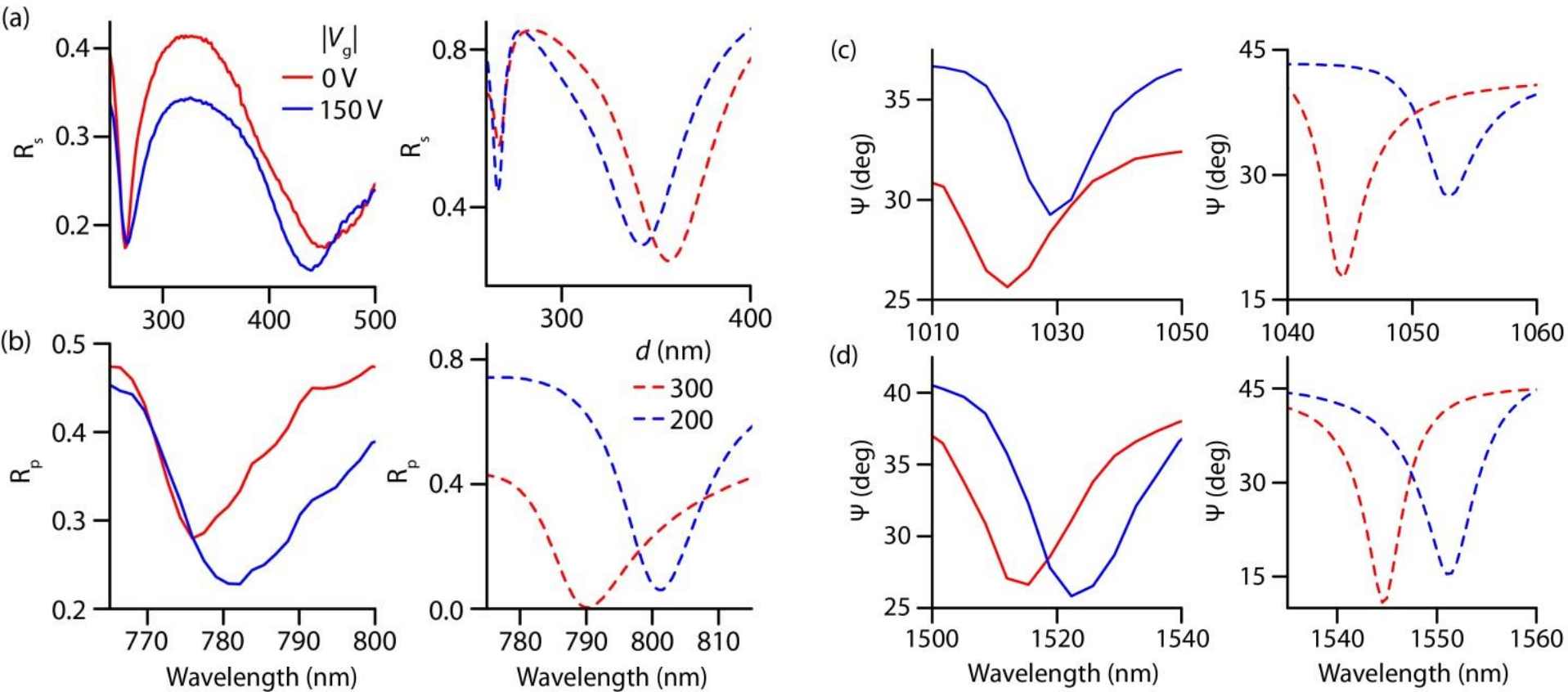
Lock-in amplifier measurements

Product of harmonic oscillator and overdamped electrical response (damping $f = 8$ kHz)

Mechanical resonance frequency ~ 120 kHz

(Theoretical maximum frequency ~ 100 MHz)

RCWA modelling



$R_{p,s}$ vs cavity size

