

Low-dimensional Materials for Advanced Biosensing Applications



EPIC Online Technology Meeting on
Photonics for Wearables



Presenter

XPANCEO



Valentyn S. Volkov

Co-Founder, CTO

An internationally renowned expert in the field of nanophotonics and advanced materials, with 20 years of experience at leading universities and research centers.

What would be perfect?

Functionality

All of your gadgets combined
in one unlimited screen.

Form-factor

Best device is no device.
Invisible. Weightless. Private.

Health

Improve your eyesight
instead of damaging it.

Roadmap

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Supervision

- Night Vision.
- 3D vision.
- 2H 2024.



Sensory

- Instant measurement of many parameters: Dry eye, Cortisol, Glucose, Heart rate, IOP, Temperature.
- 1H 2025.



Holographic

- Seamless AR experience
- Anything as a screen.
- Visual control of the smart home with no device.
- New powers to communicate & collaborate.
- 2H 2025.



Perfect SCL

- Includes all options.
- 2026.



User can wear the SCL as normal weekly or monthly prescription contacts, or use 1-time variant at check-up point.

Key Benefits:

- Instant measurement of many parameters.
- As simple as a glance.
- High accuracy due to no obstructions.

Sensors

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Single
molecule
detection

Ultrasensitive
sensors
for glucose

Topological phase singularities in atomically thin high-refractive-index materials.

Nature Communications 13, 2049 (2022)⁸

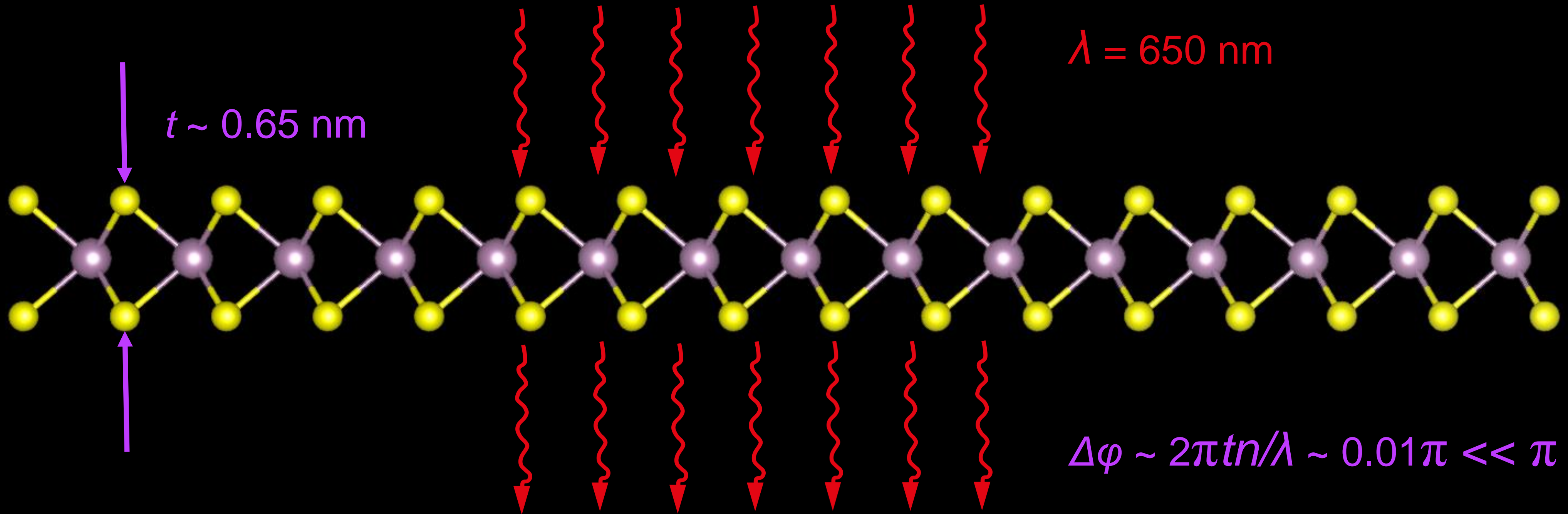
Ultrasensitive biosensors

based on topology in 2D PdSe₂ were developed by XPANCEO team.

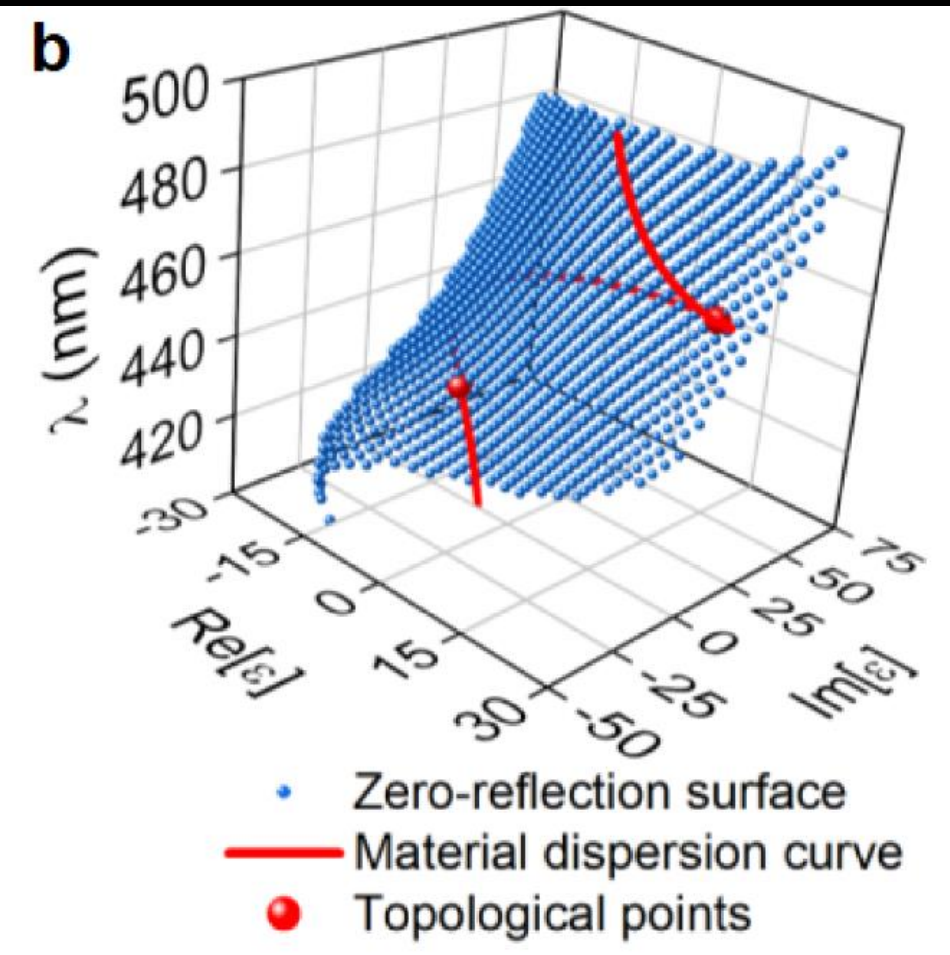
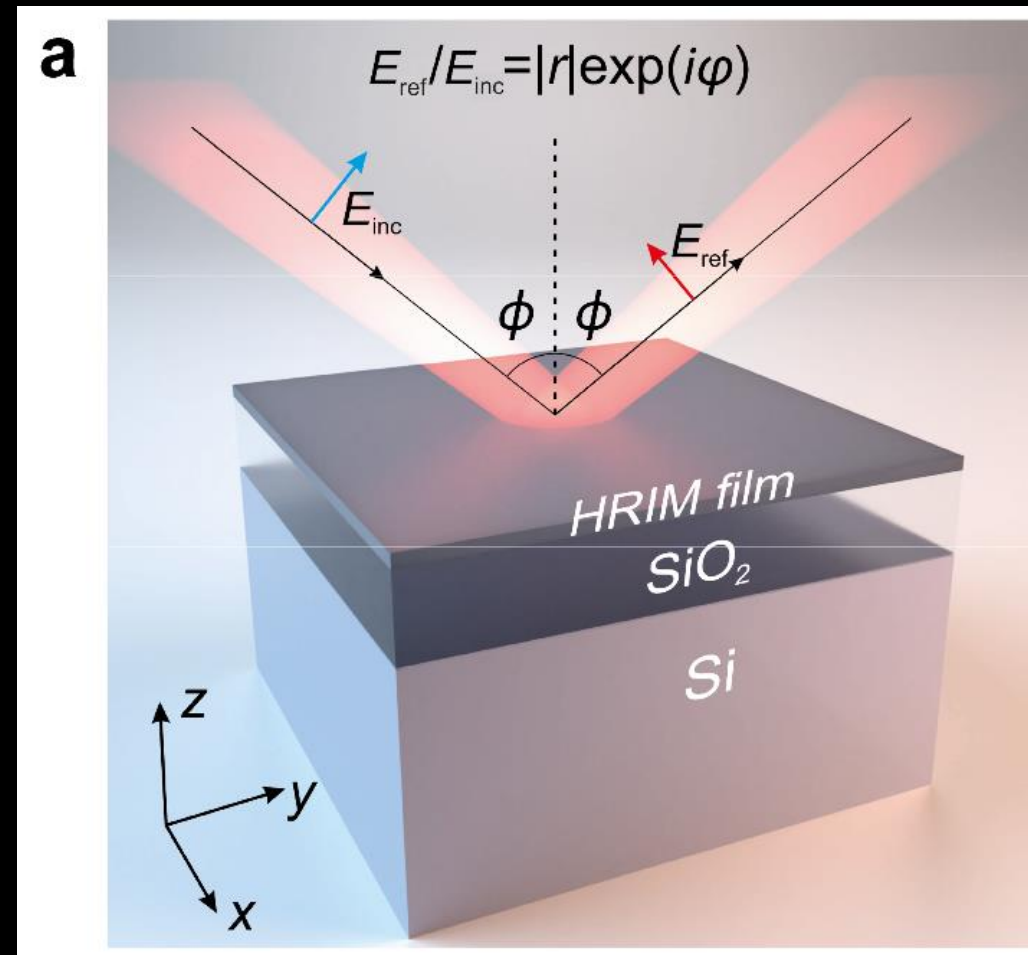


Problem of 2D Flat Optics

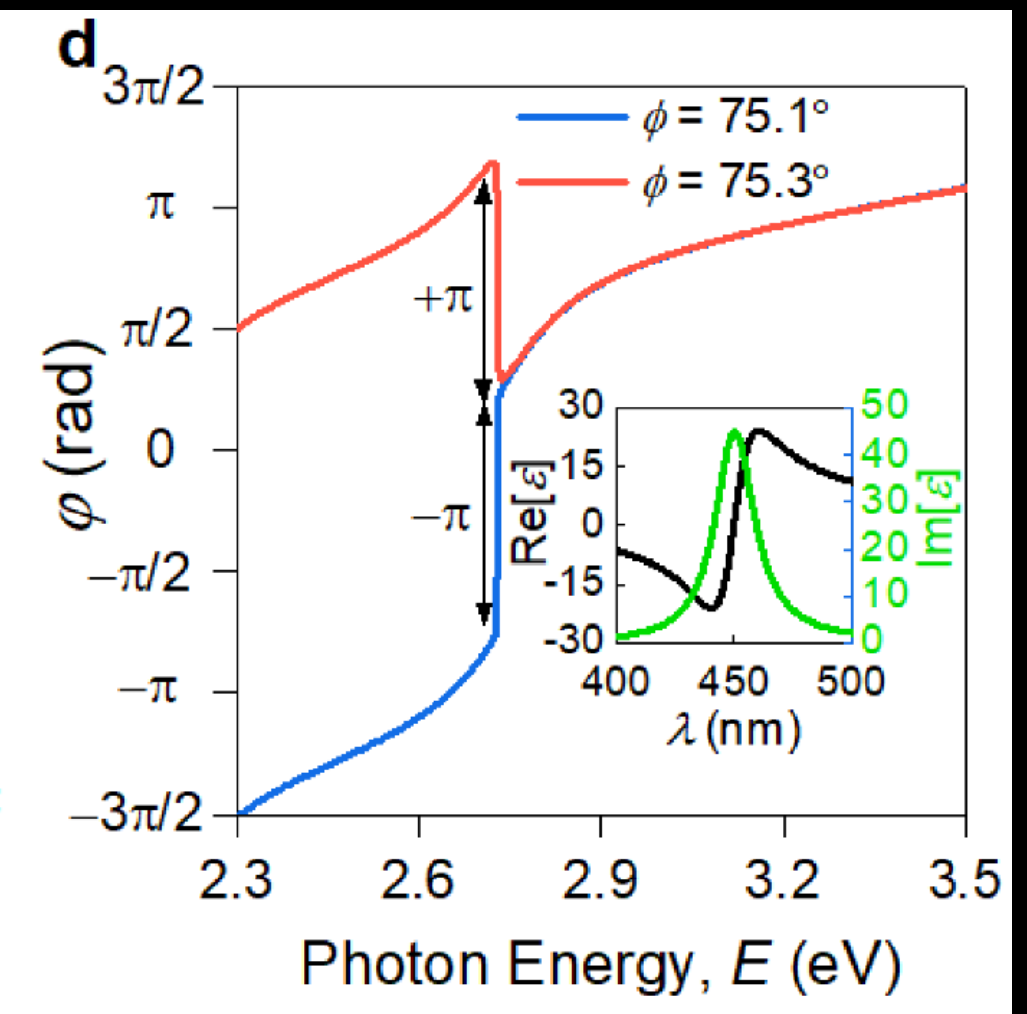
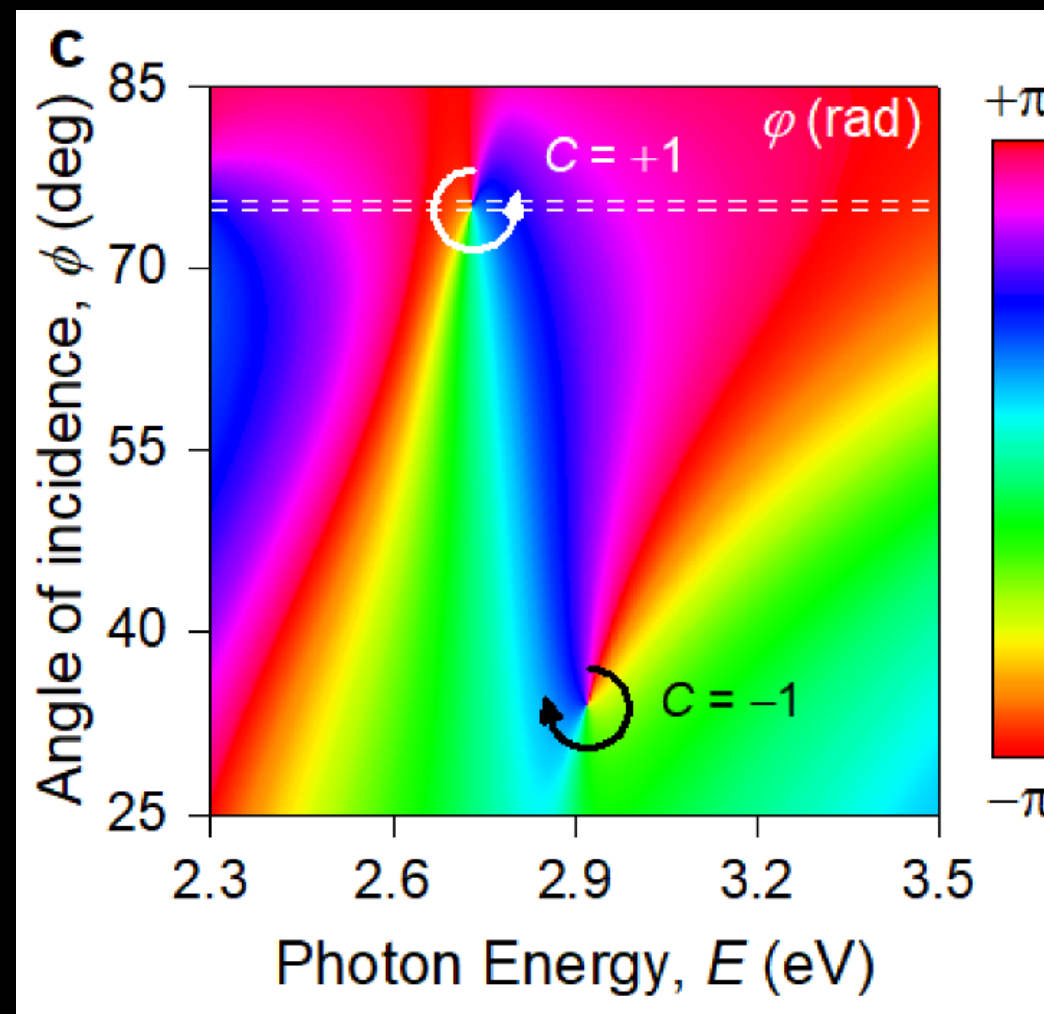
Efficiency of current optical 2D devices $\sim 1\%$



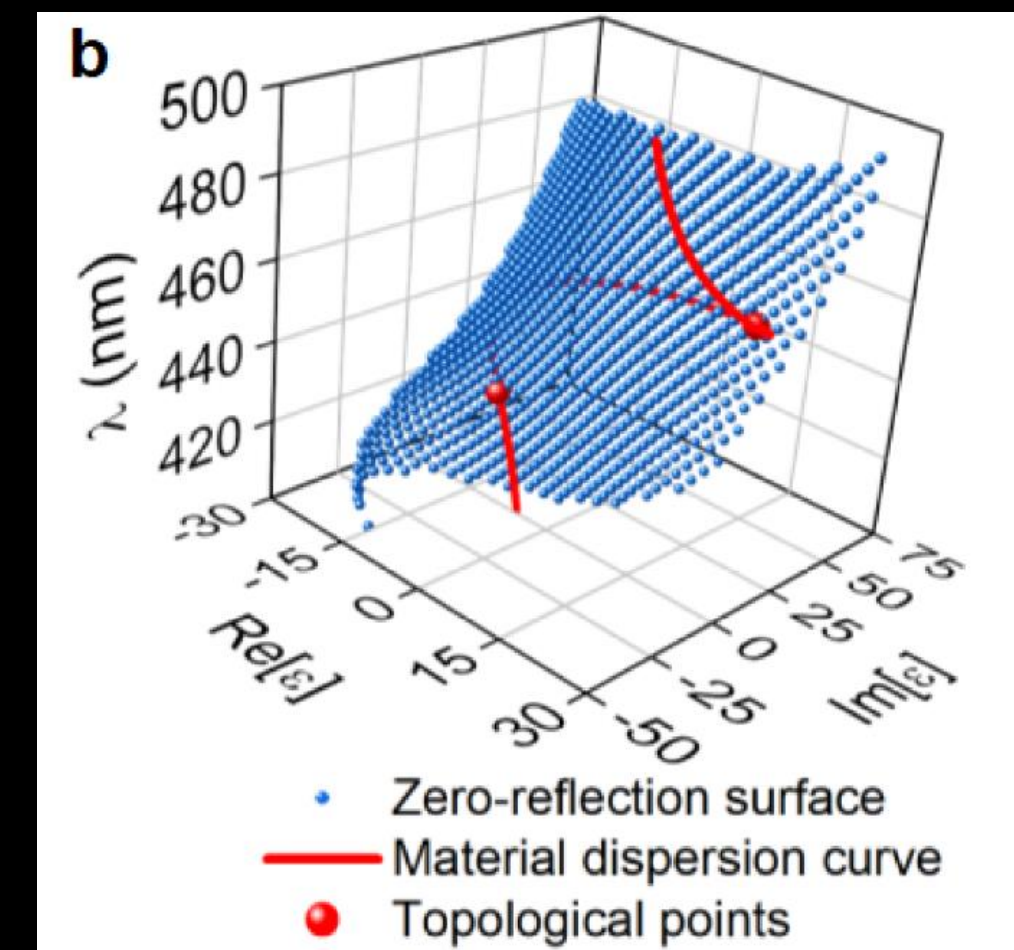
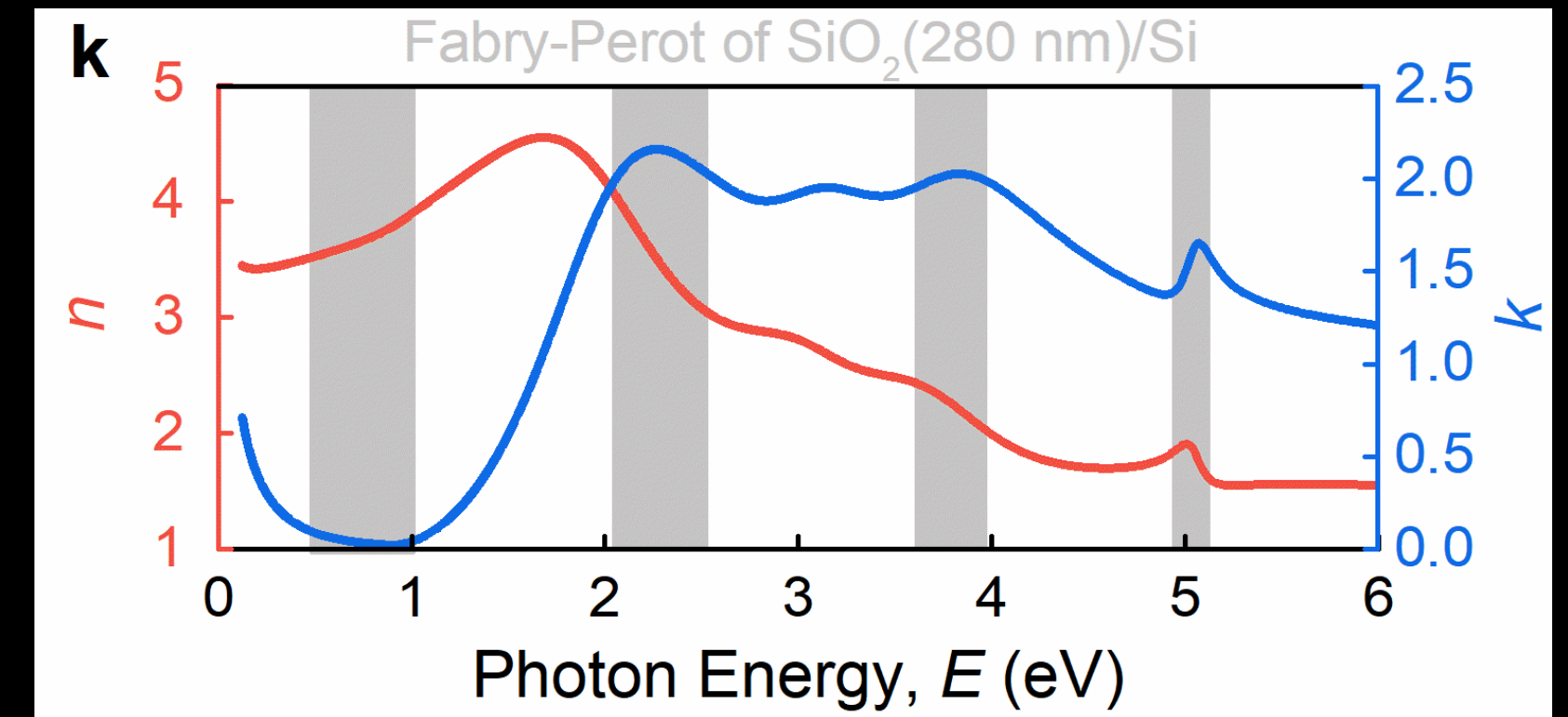
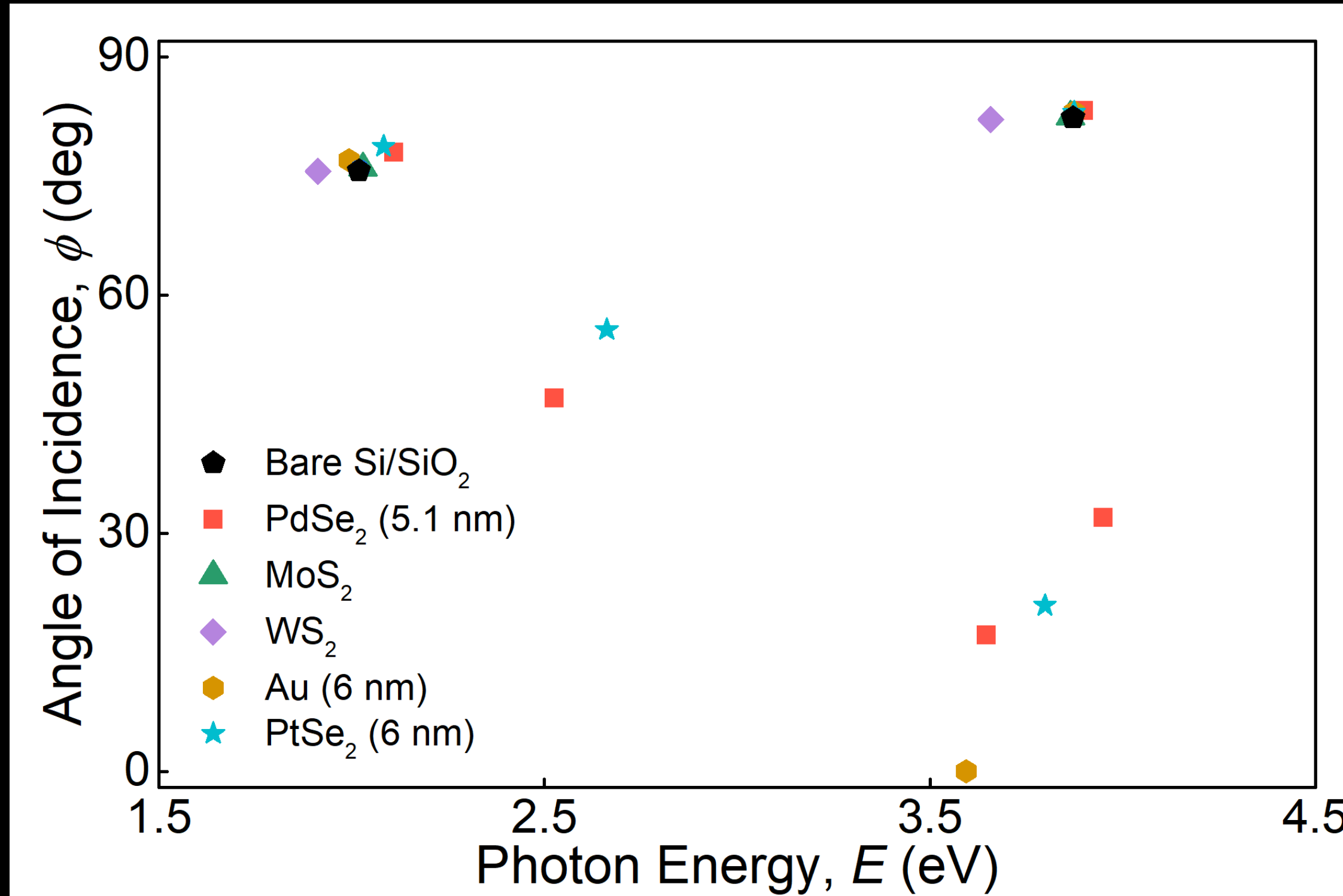
Proposed Concept



$$C = \frac{1}{2\pi} \oint \nabla \varphi ds$$

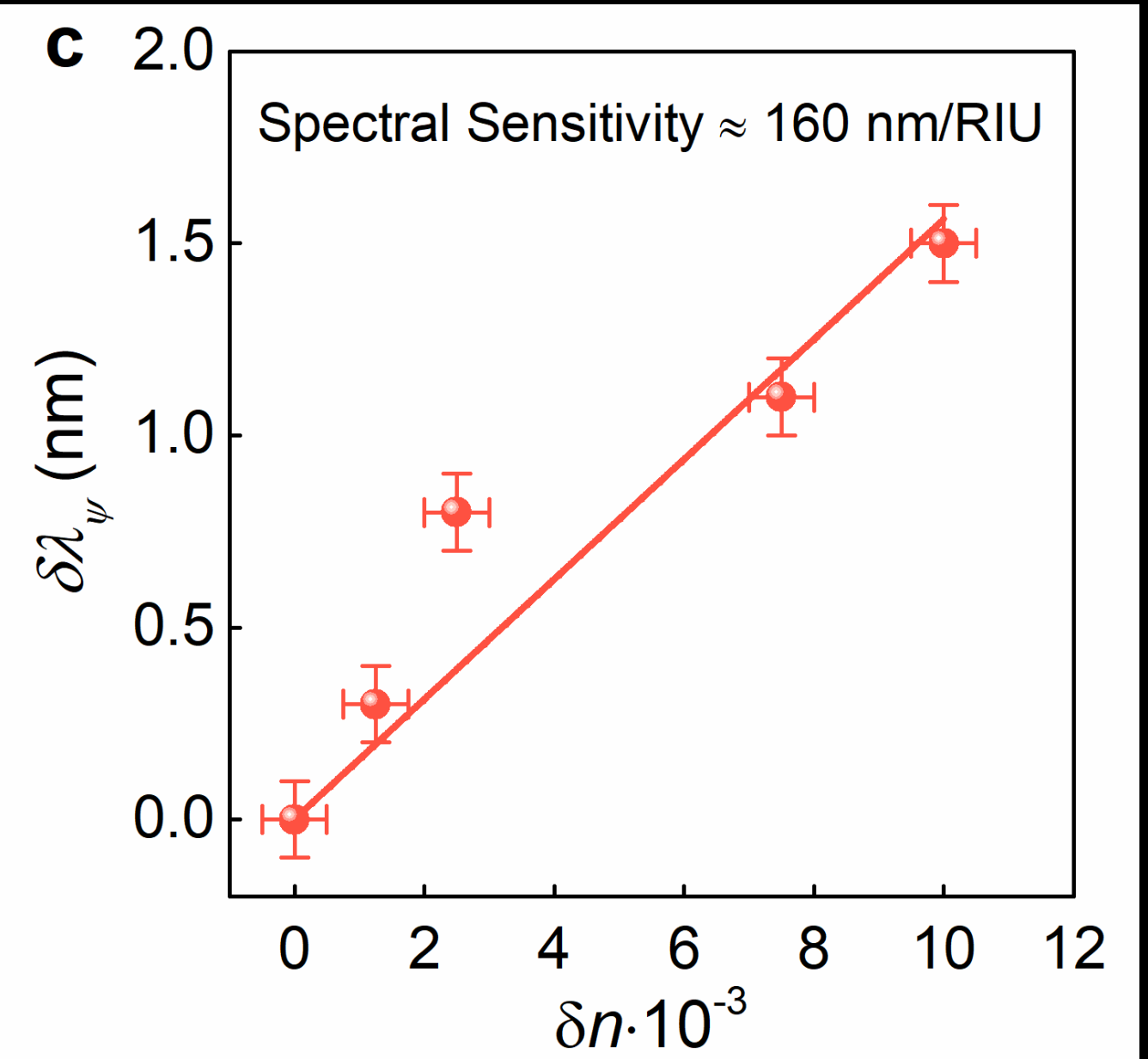
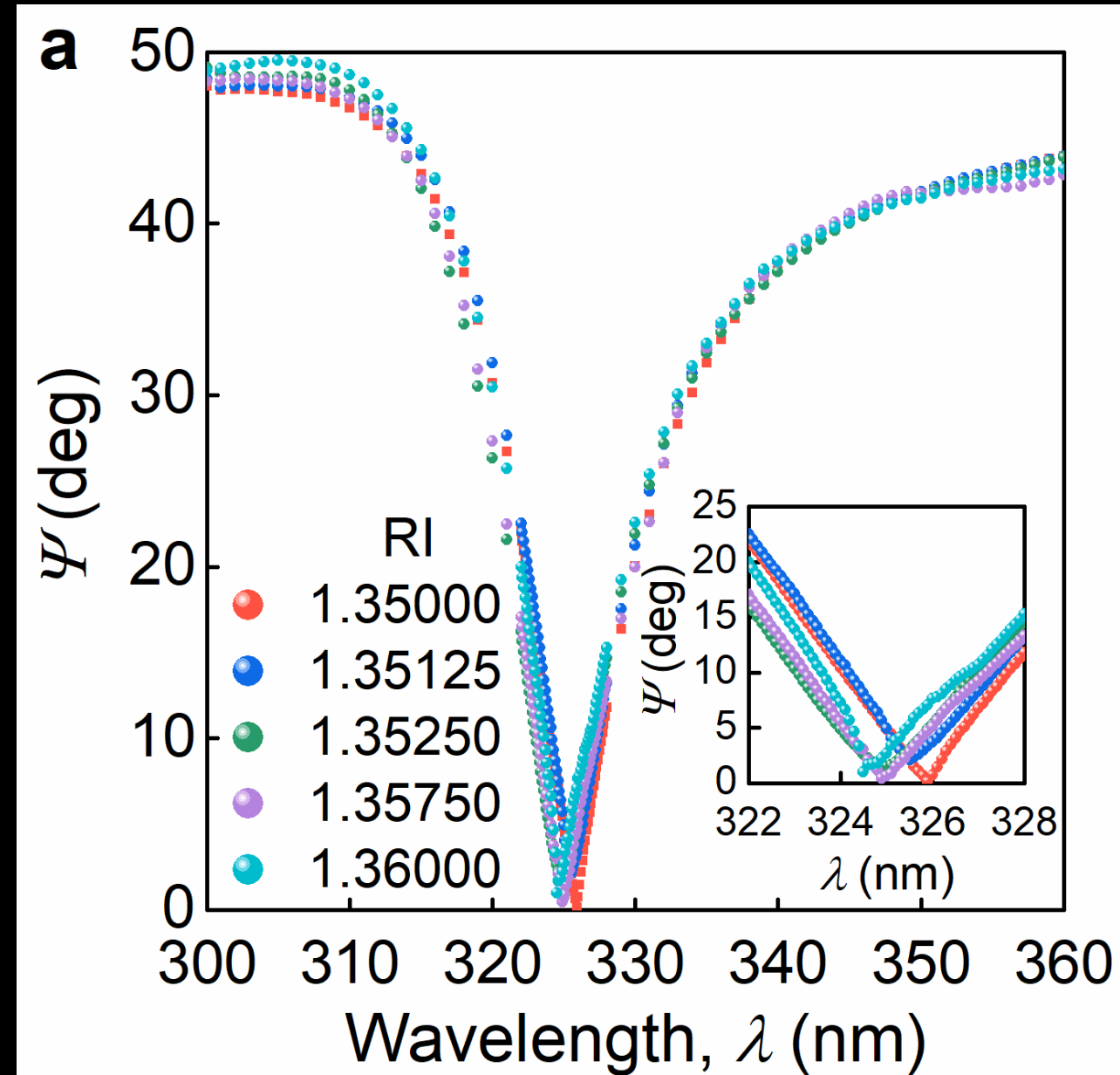
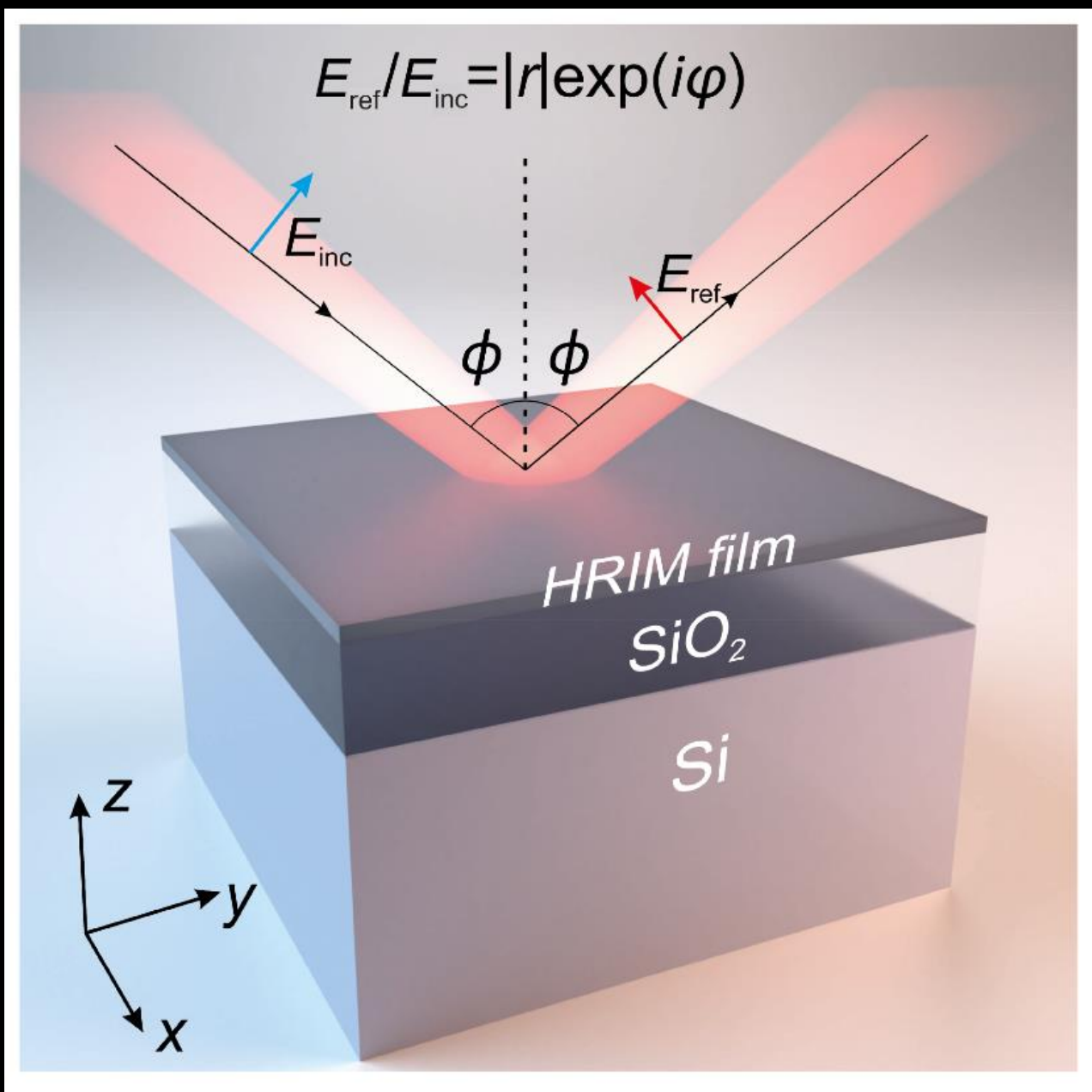


Phase Topology in High- n k materials

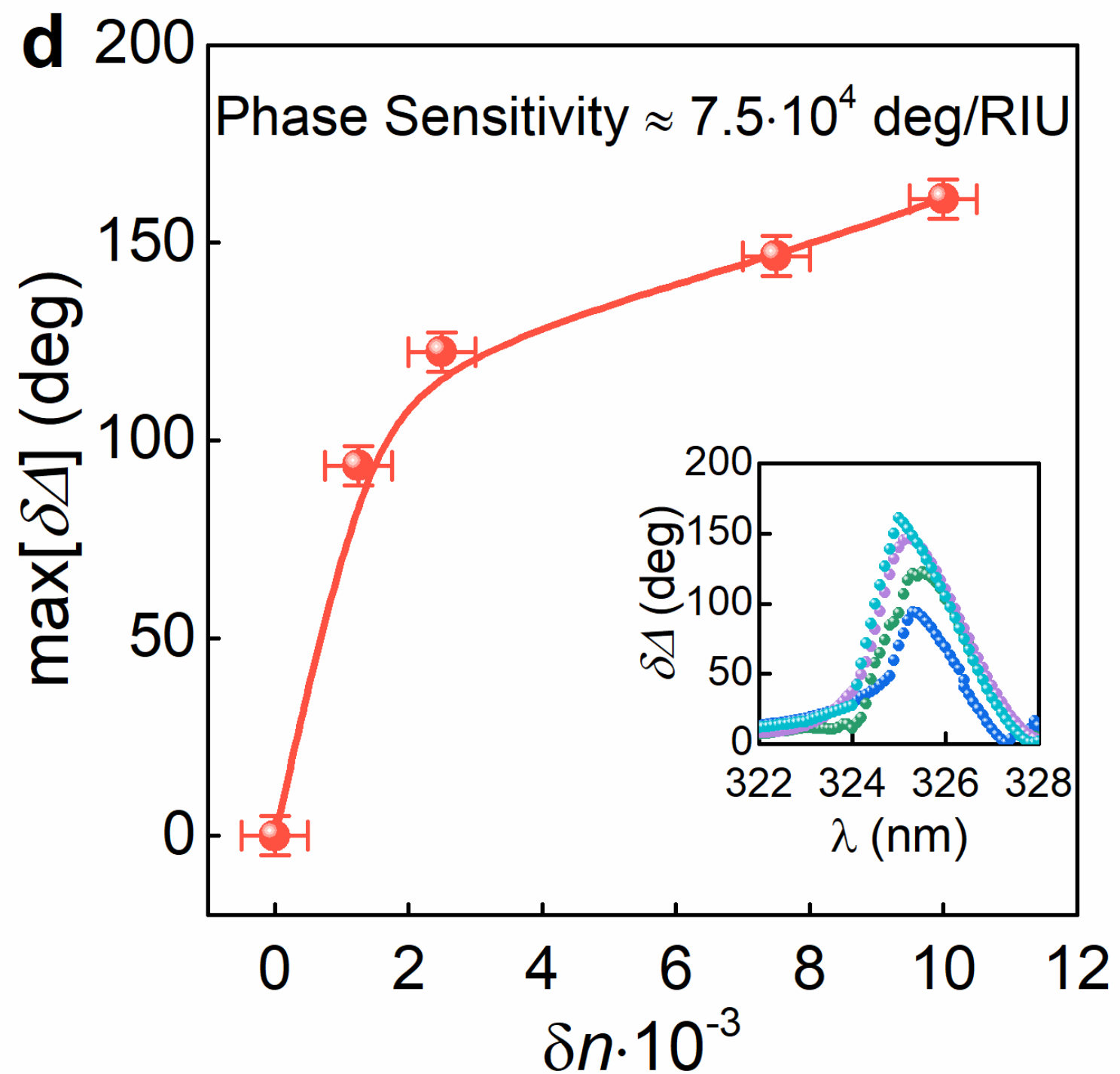
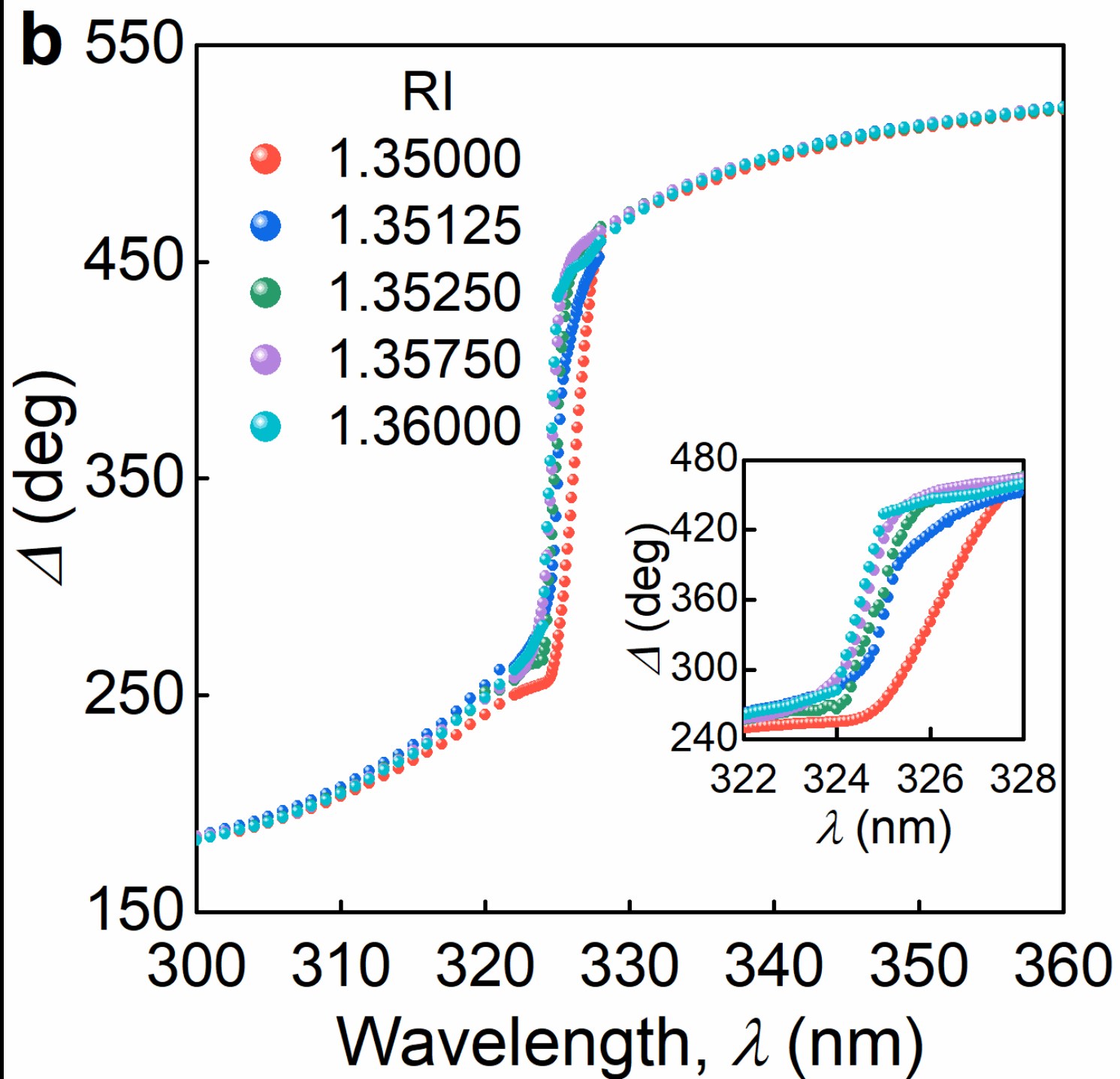


Topology-Based Biosensor – Amplitude

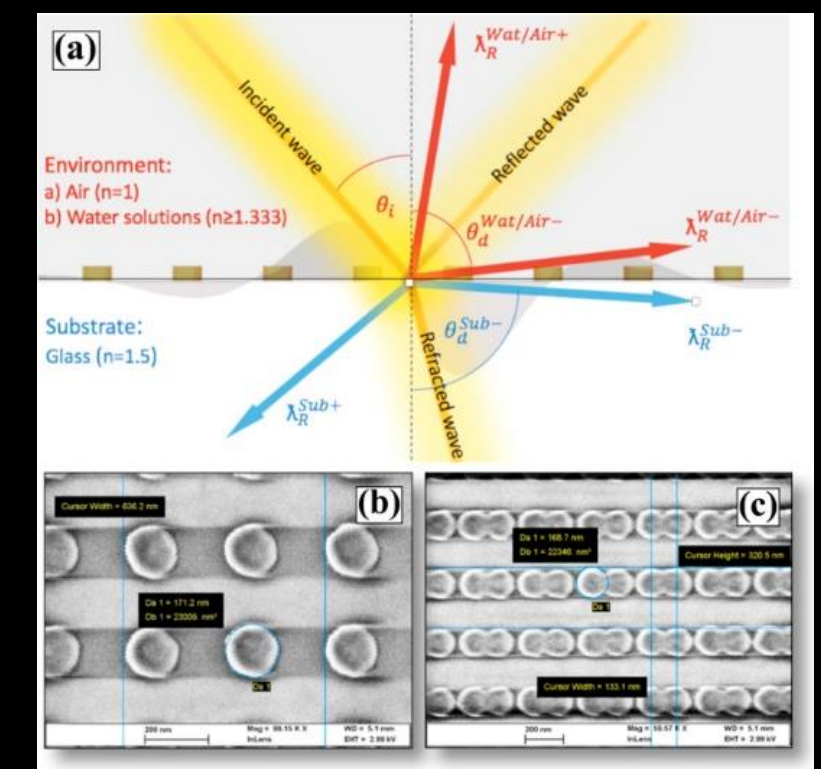
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Topology-Based Biosensor – Phase



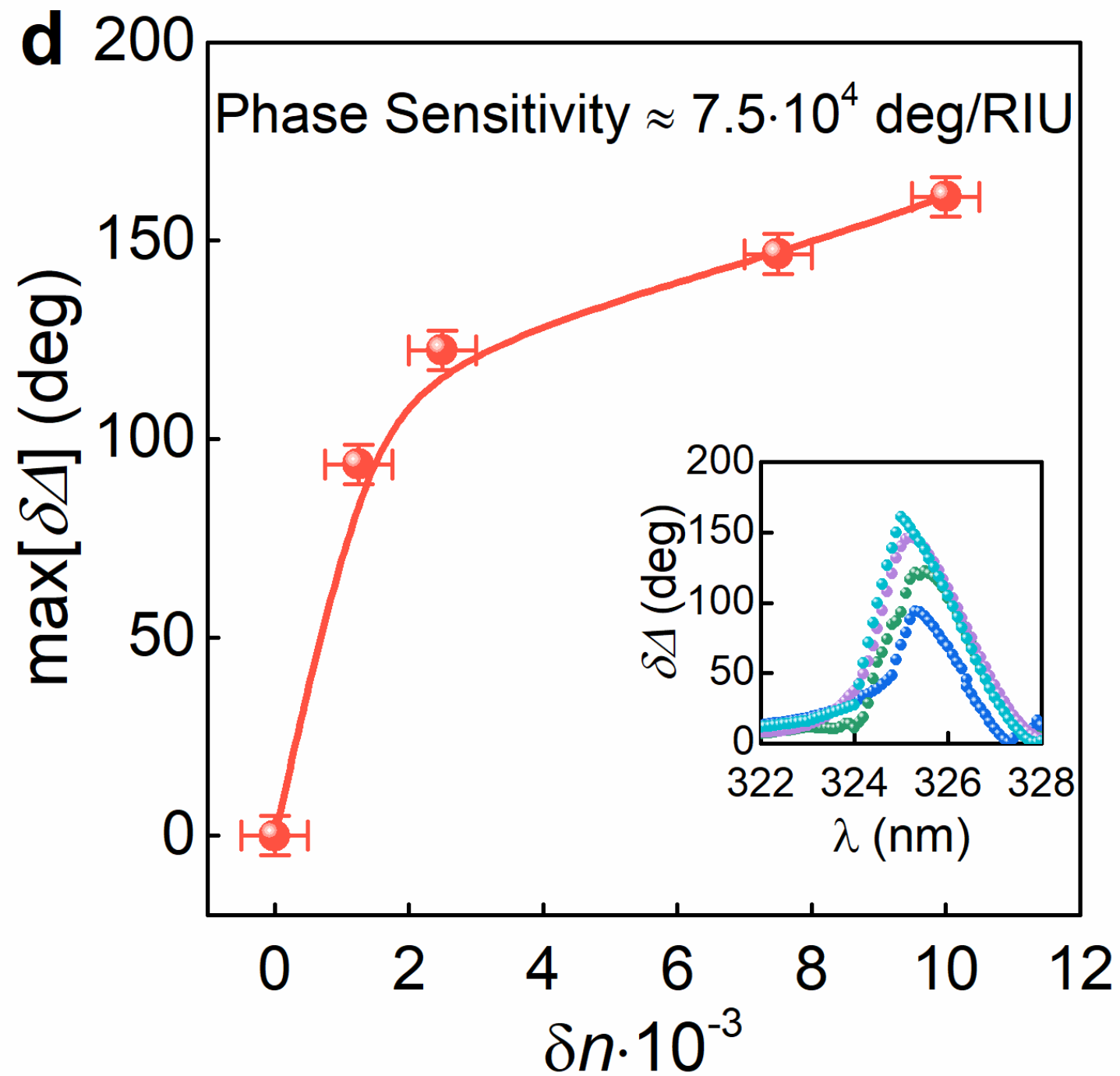
Plasmonic surface
lattice resonances:
 $5.7 \cdot 10^4$ deg/RIU



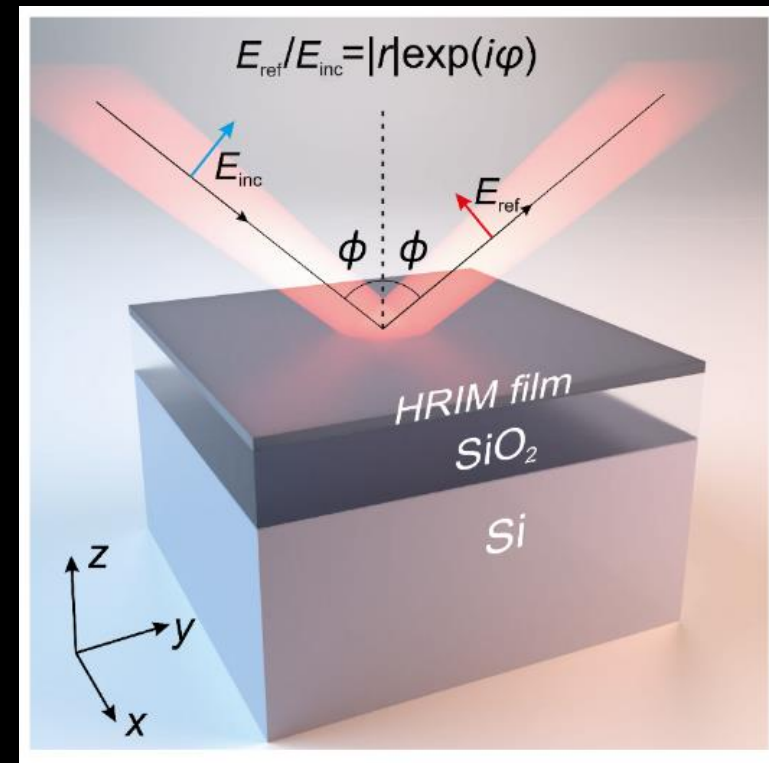
[1] Danilov et al.,
Biosens. Bioelectron. (2018)

Biosensor Advantages

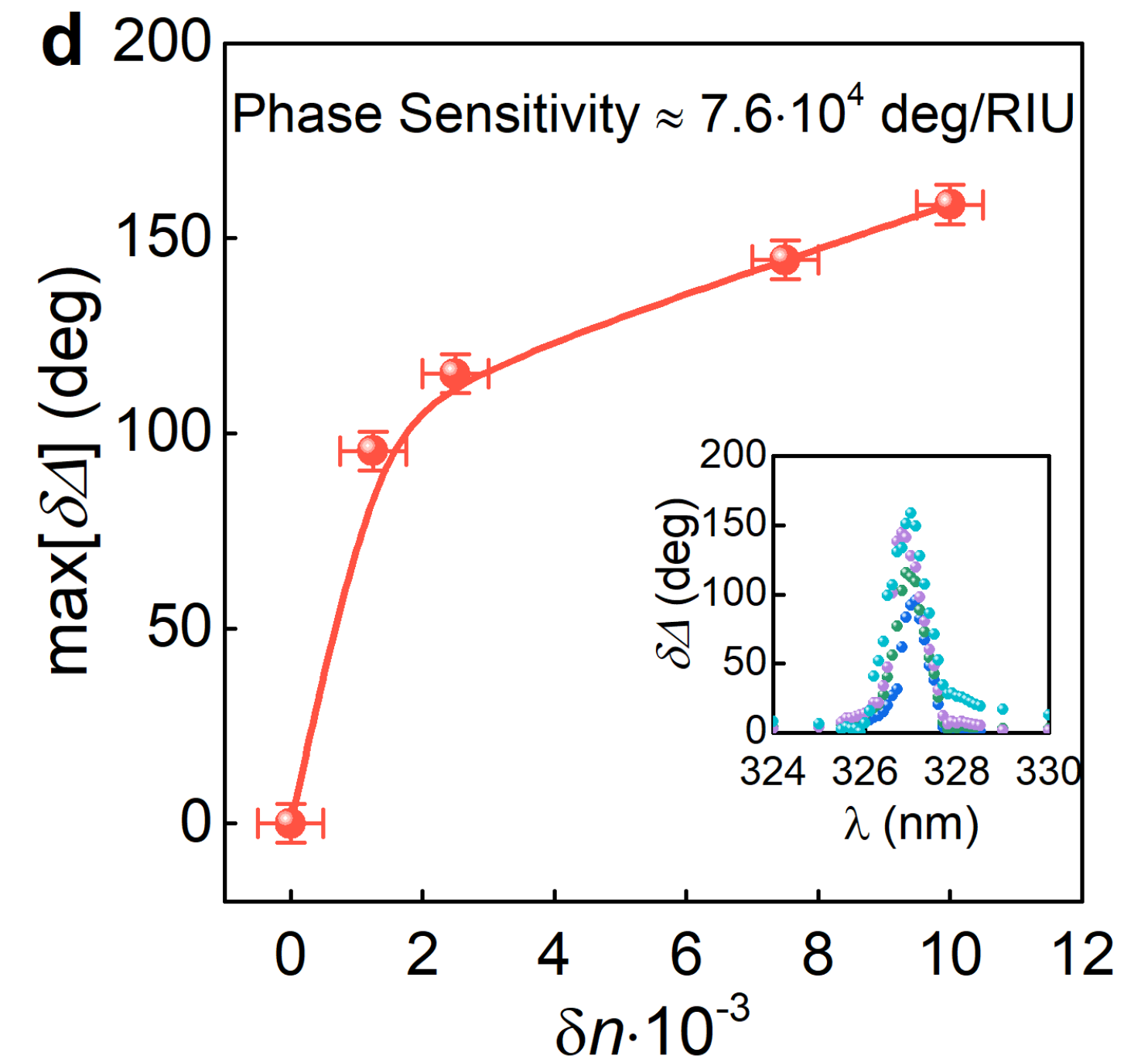
As prepared:



$\Delta\lambda = 1.4$ nm
 $\Delta\varphi = 1.0^\circ$



After 9 months:



- ✓ Robust
- ✓ Scalable
- ✓ Cheap
- ✓ Easy-to-use
- ✓ Easy-to-fabricate

Partner with us

Consumer electronics company

AR-driven software companies and platforms

**Component manufacturers:
sensors,
waveguides**

Let's talk!

Contact us:

 hello@xpanceo.com

 www.xpanceo.com

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