Biosensing via controlling light at the nanoscale

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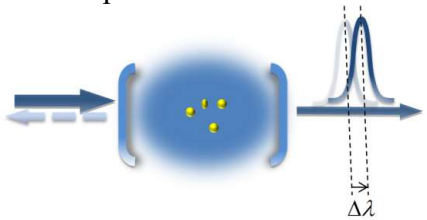
Nanobeam Cavity
Silicon photonic crystal biosensor (Lab-on-a-chip)

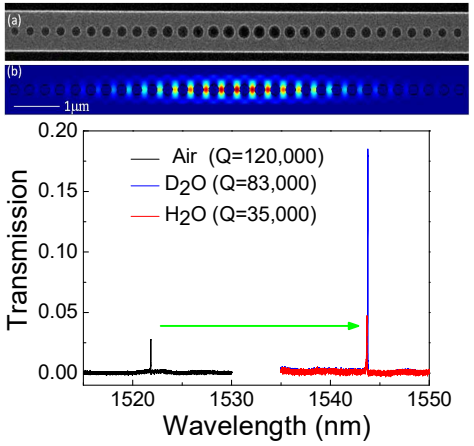
Motivation
The key to make a good sensor is to enhance the interaction between photons and molecules

Challenge
- Most molecules are non-fluorescent
- Scattering is weak because optical diffraction limit prevents light focusing at the molecule scale

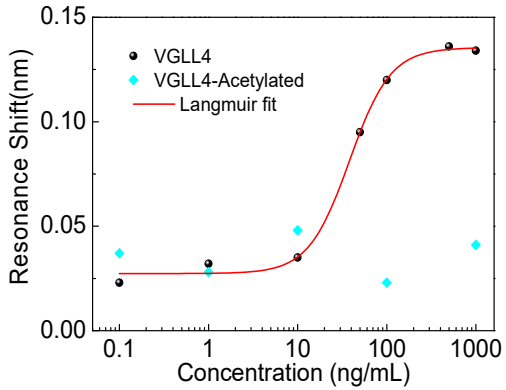
Solution
Build an optical cavity to trap photons, increase the interaction time between photons and molecules.



Device: photonic crystal cavity



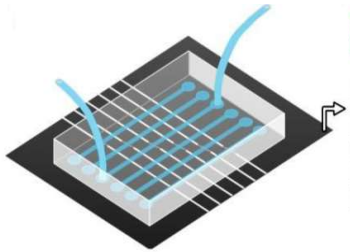
Application: Study protein affinity
Background: Cardiac cell regeneration is regulated by TEAD/VGLL4
Result: Acetylated VGLL4 lost affinity to TEAD

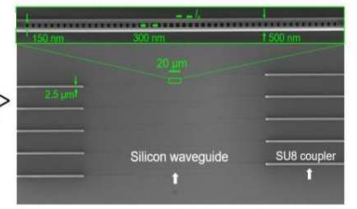


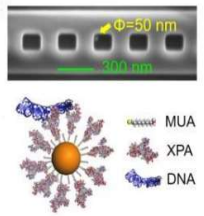
Application: Diagnostics
Background: No diagnostics biomarkers for Alzheimer's disease in blood
Result: Tau/Aβ as potential biomarkers

Sensitivity (pg/mL)	PBS	Serum
Nanobeam	0.01	1
Gold standard assay	0.1-1	100

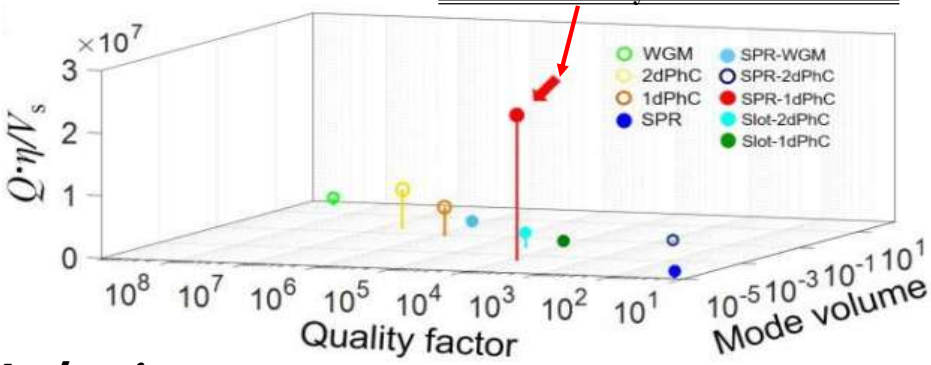
Impact
- Single nanoparticle level sensitivity (1.8nm)
- Widely applicable to measure small protein affinity (~kDa) And ***Single molecular interaction study***



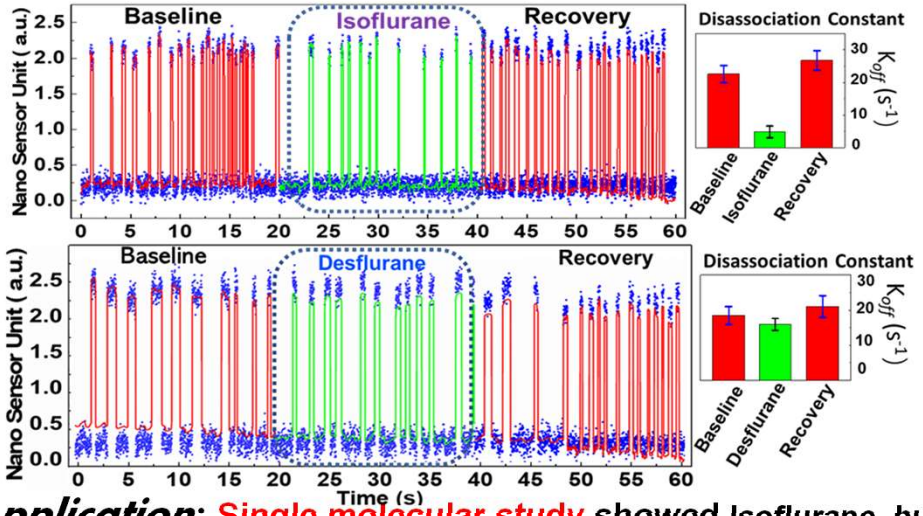




Merit: Sensitivity enhance ~1000 times



Mechanism: **Single molecular interaction study is based On the gold particle enhanced nanobeam cavity sensor.**



Application: **Single molecular study showed Isoflurane, but not Desflurane impairs the interaction of ADP and ATP synthase.**