Less Noisy & Highly Sensitive Graphene N-pores for Ultra-fast DNA Sequencing

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Origin & Concept of Nanopore

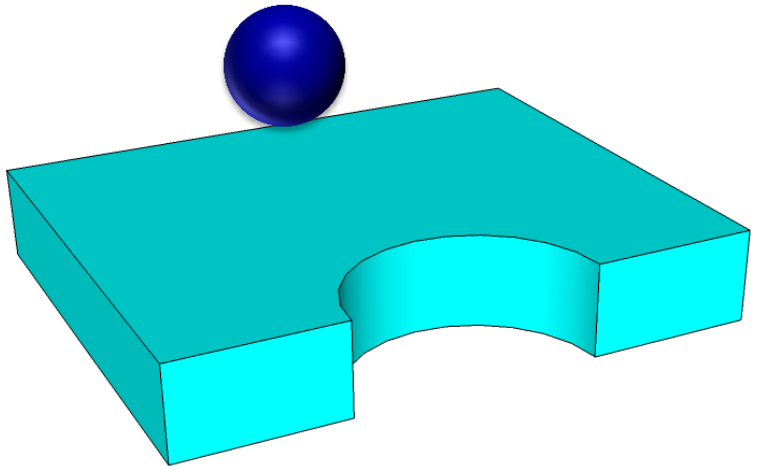
Stack Structures
Other 2D materials

2010
Graphene N-pores

2001
Solid State N-pores

1996
First Sensing

1989



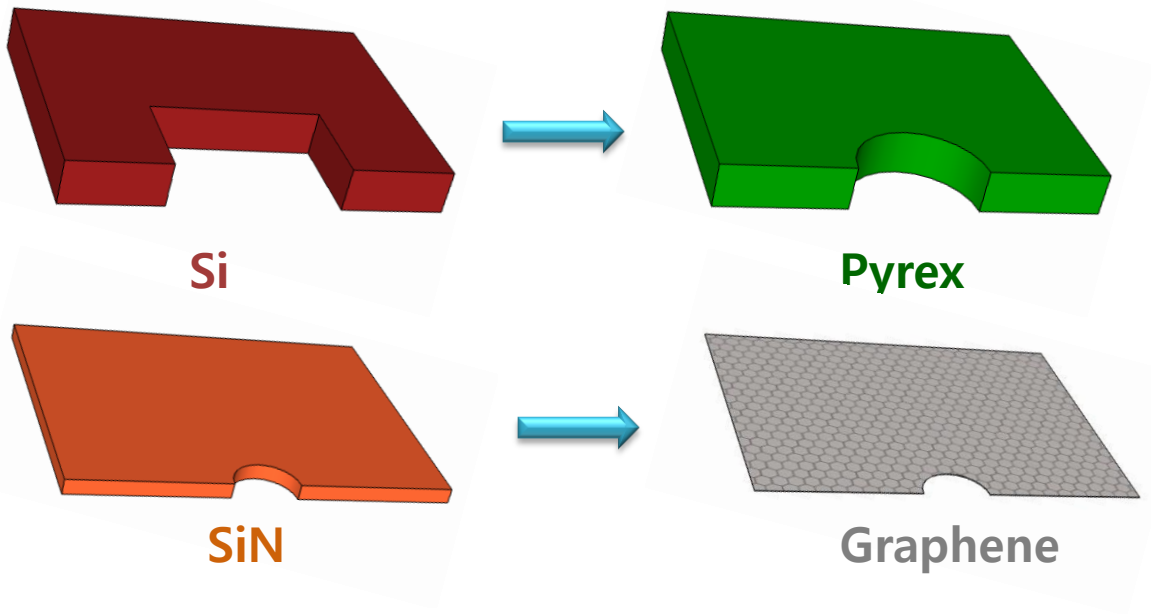
Higher Ionic Current Noise

Signal to Noise Ratio

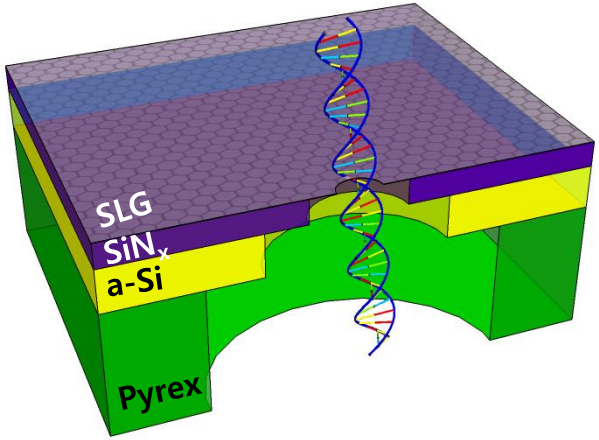
Limited Bandwidth

Resolution

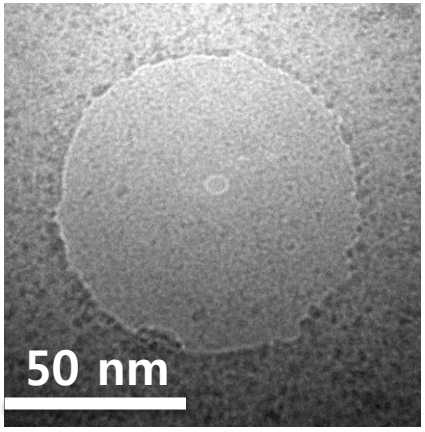
Approach towards improving solid-state nanopores



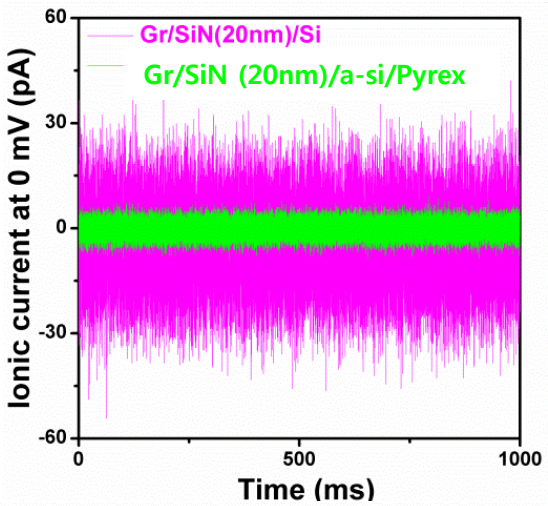
Materials	ε	D_{loss}
Si	11.8	$5\sim15\times10^{-3}$
Pyrex	4.6	1×10^{-3}



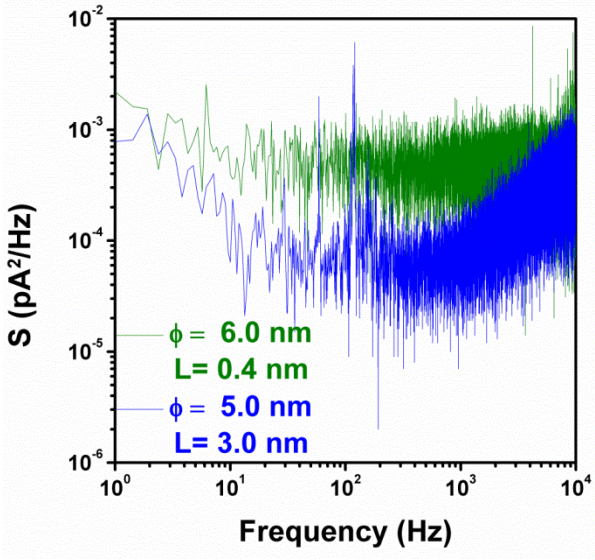
Materials	Dimessions	Purpose
a-Si/Pyrex	Pore size ($5x5\ \mu m^2$)	✓Dielectric noise reduction
SiN_X	Th. = 20 nm Φ = 70-80nm	Reduces: ✓Graphene layer fluctuations ✓Pin-hole effects
Graphene	0.3-3.0nm Φ= 5-6 nm	✓Improved spatial resolution ✓Better sensing capability



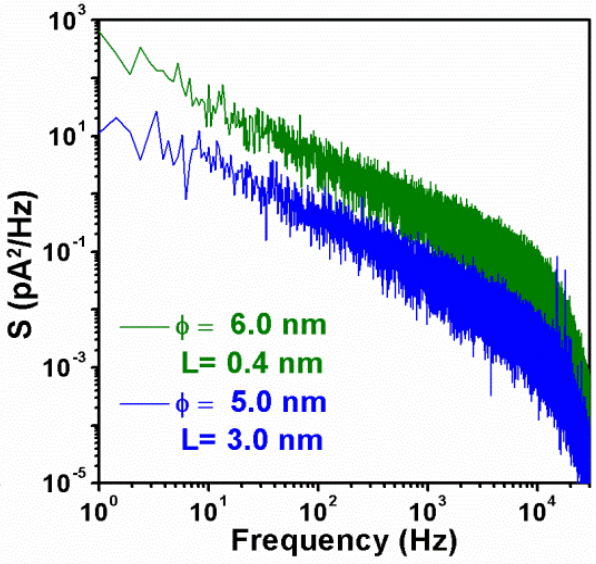
Improved noise characteristics and temporal resolution



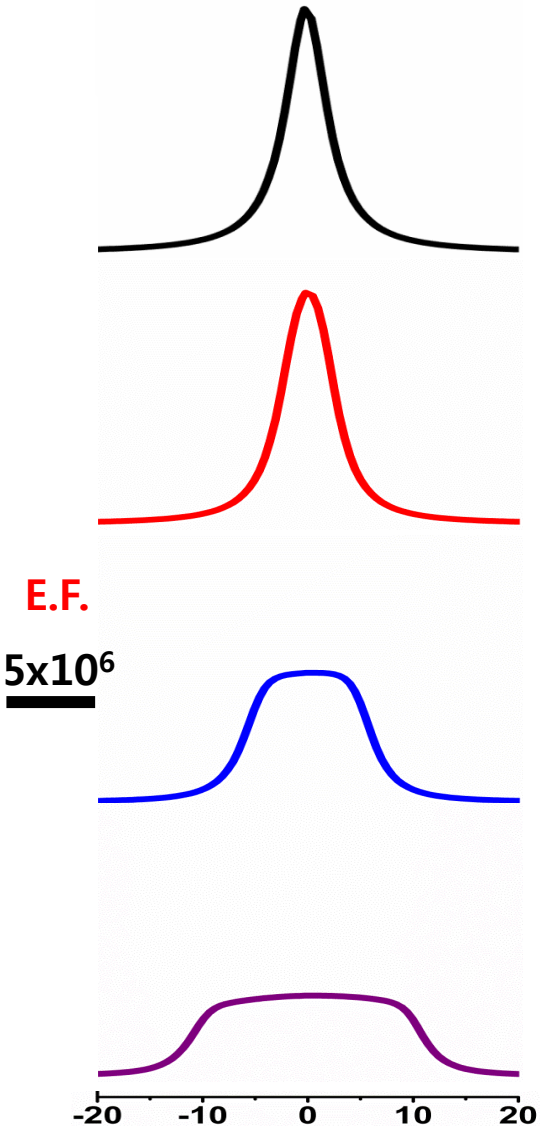
Noise parameters	Gr/SiN/Si	Gr/SiN/ Pyrex
A	1.3×10^{-1}	6.1×10^{-3}
B	3.9×10^{-2}	8.6×10^{-5}
C	4.6×10^{-6}	1.6×10^{-7}
D	3.5×10^{-10}	1.2×10^{-11}
β	1	1
I_{rms} (pA)	18	2.7



$I_{rms} = 4.7pA\ (SLG)$
$= 2.3pA\ (FLG)$



$I_{rms} = 77\ pA\ (SLG)$
$= 14\ pA\ (FLG)$



Summary

- ✓ Pyrex based device posses low noise level as compared to Si based device
- ✓ This graphene nanopore presents lower noise level than reported
- ✓ Few layer graphene shows
  - ➢ Low noise level
  - ➢ Better SNR
  - ➢ Increased blockade current
  - ➢ Better mechanical stability and easy pore formation

THANK YOU