

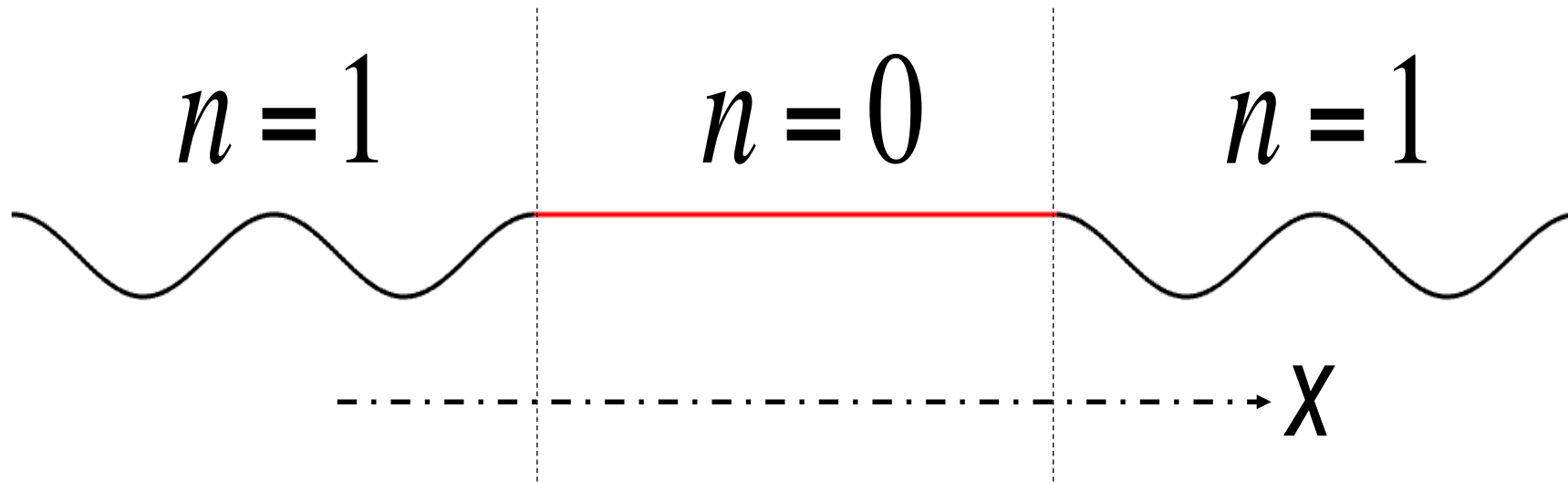
Optimization of CMOS-Compatible Zero-Index Metamaterials



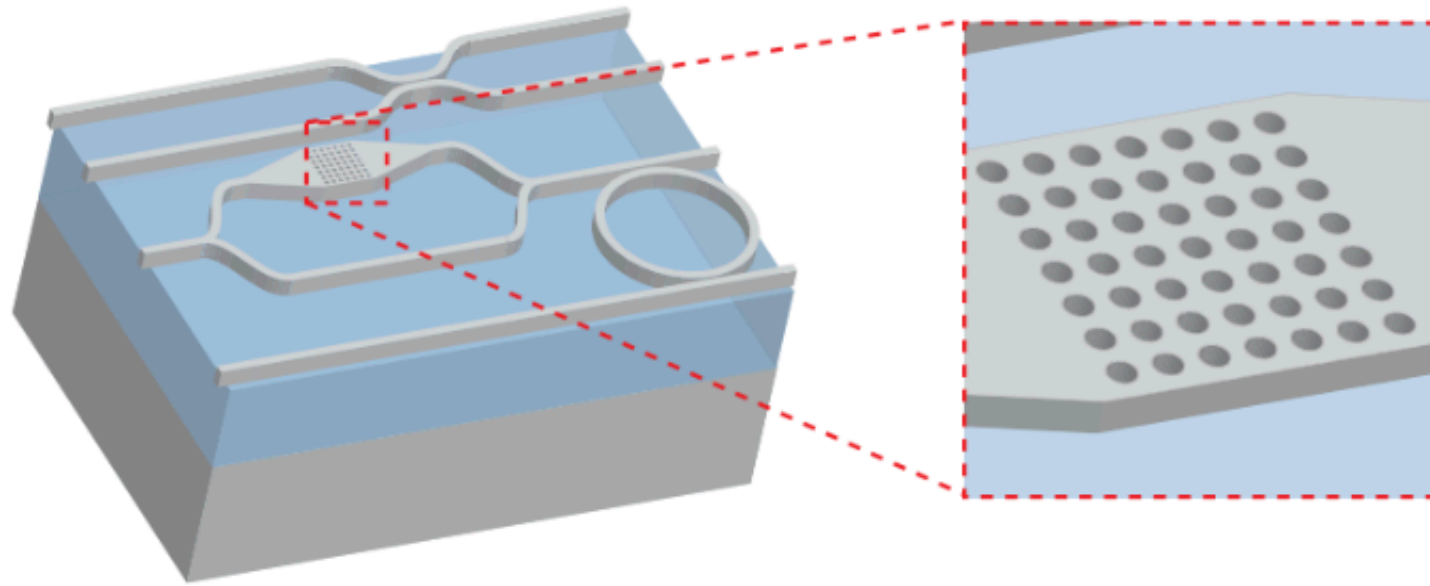
Sarah McDonald, Daryl Vulis, Eric Mazur

August 7th, 2017

What is a zero refractive index metamaterial?



Our Design



BACKGROUND

FABRICATION

CHARACTERIZATION

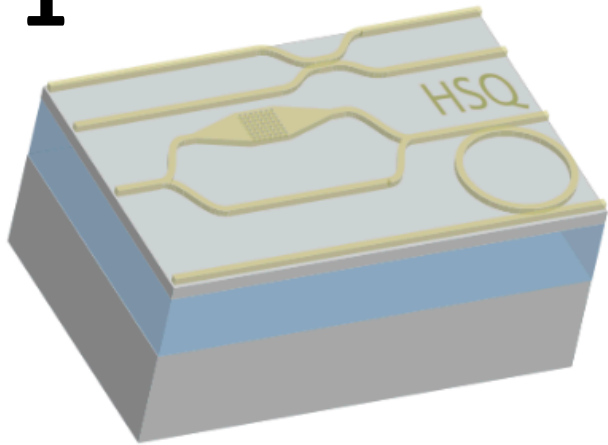
What is causing the wavelength shift?

What is causing the wavelength shift?

1. Thickness of Si Device Layer
2. Etch Depth
3. Sidewall Profile

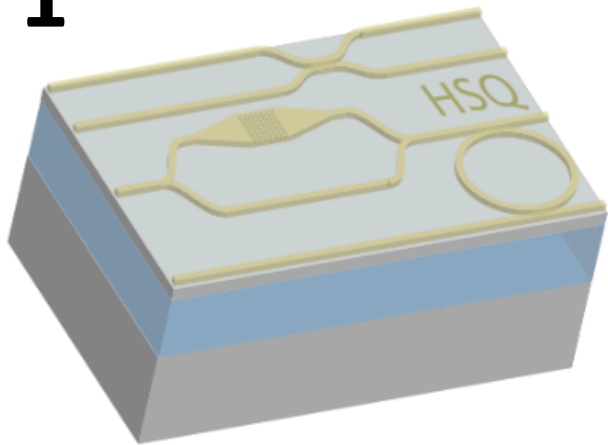
Fabrication Procedure

1

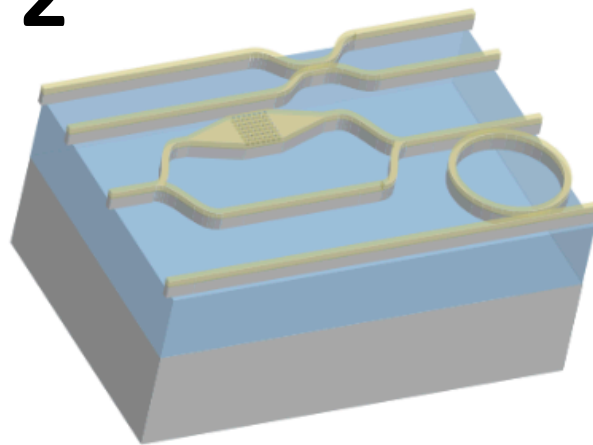


Fabrication Procedure

1



2



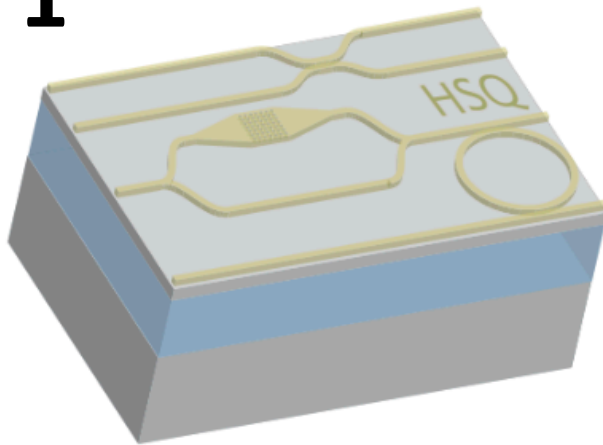
BACKGROUND

FABRICATION

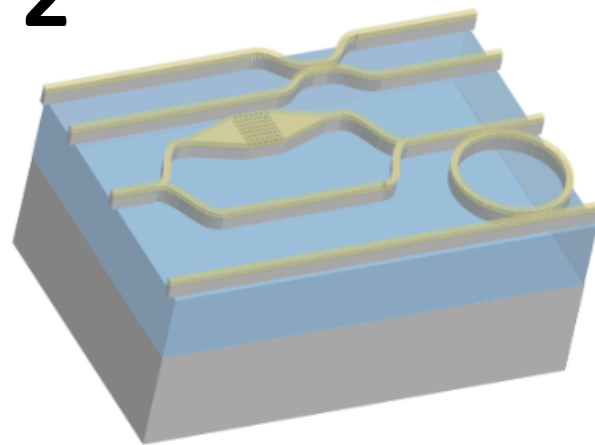
CHARACTERIZATION

Fabrication Procedure

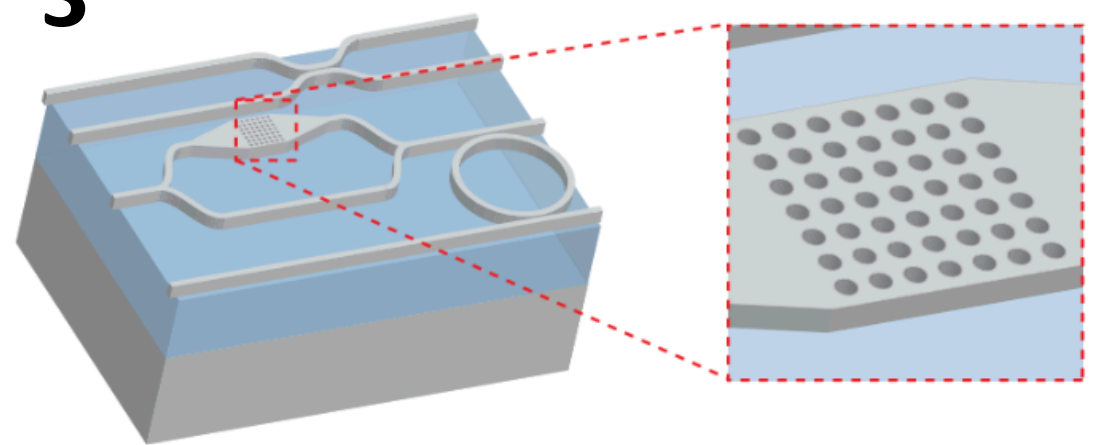
1



2



3



BACKGROUND

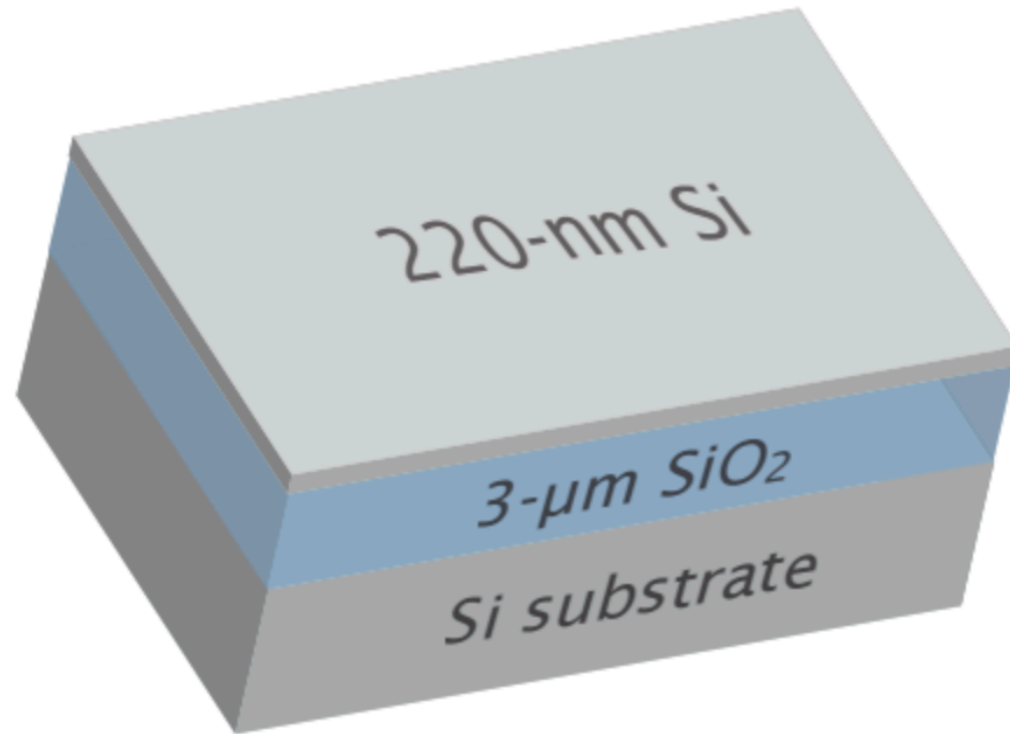
FABRICATION

CHARACTERIZATION

What is causing the wavelength shift?

1. **Thickness of Si Device Layer**
2. Etch Depth
3. Sidewall Profile

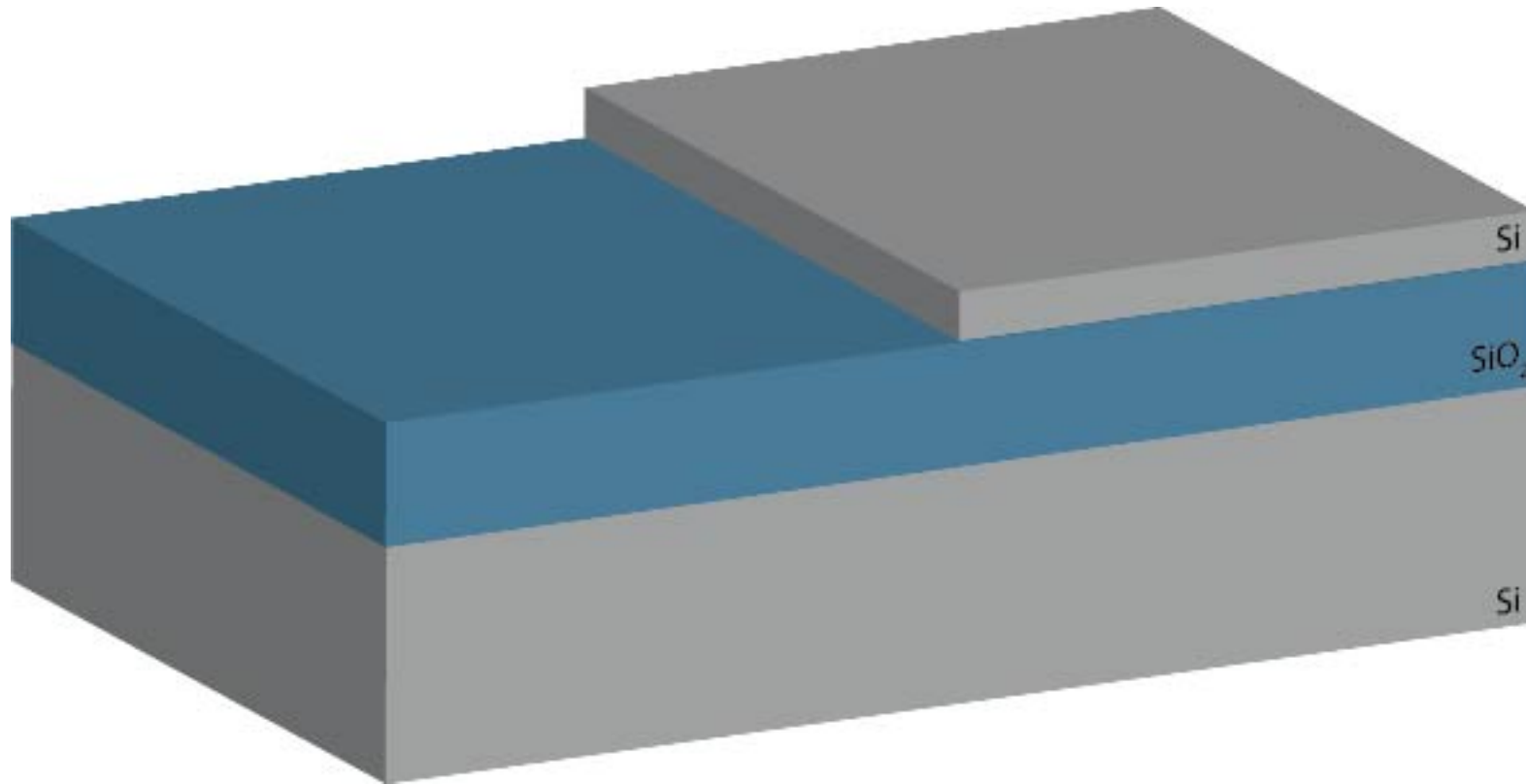
Film Thickness



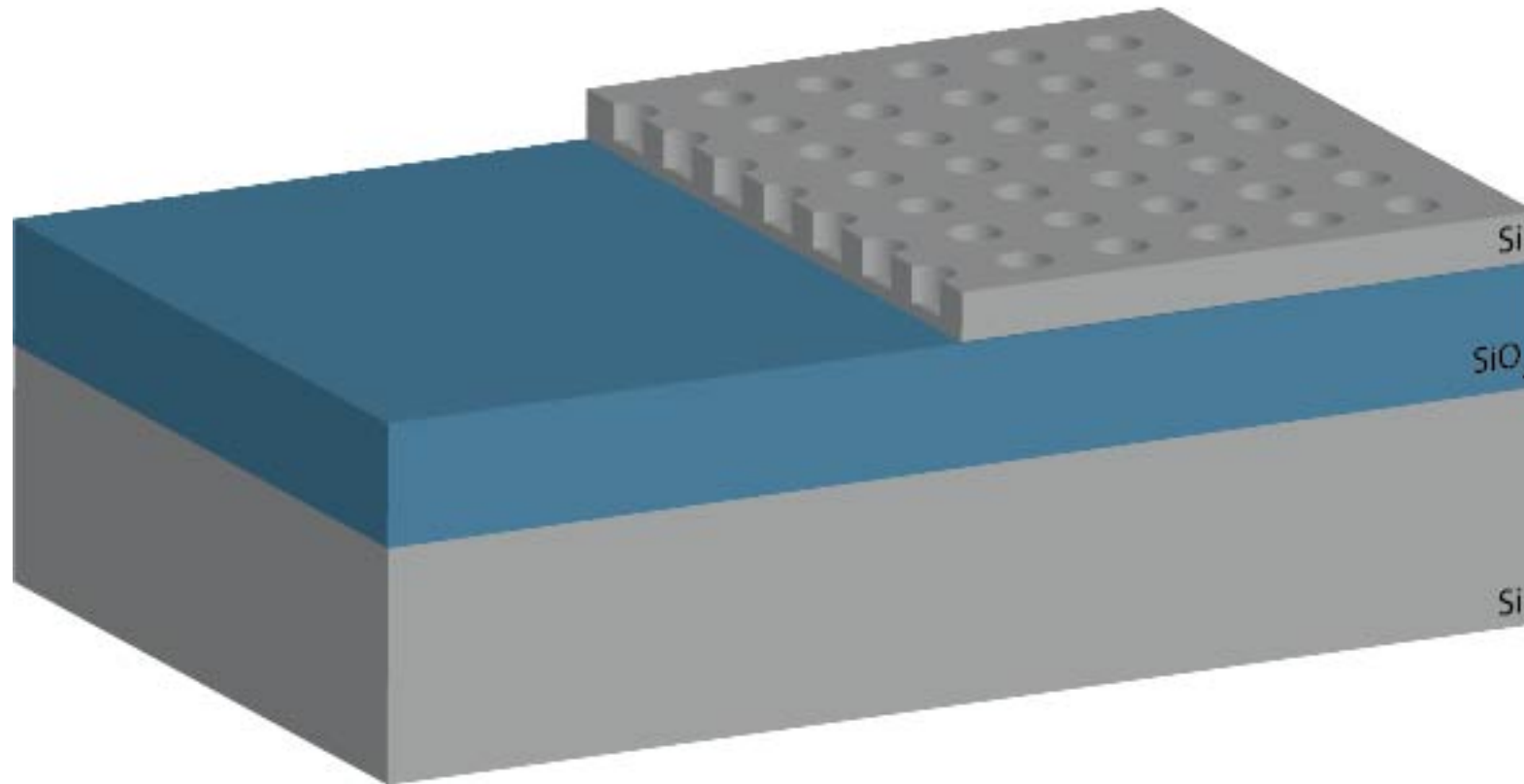
What is causing the wavelength shift?

- ~~1. Thickness of Si Device Layer~~
- 2. Etch Depth**
3. Sidewall Profile

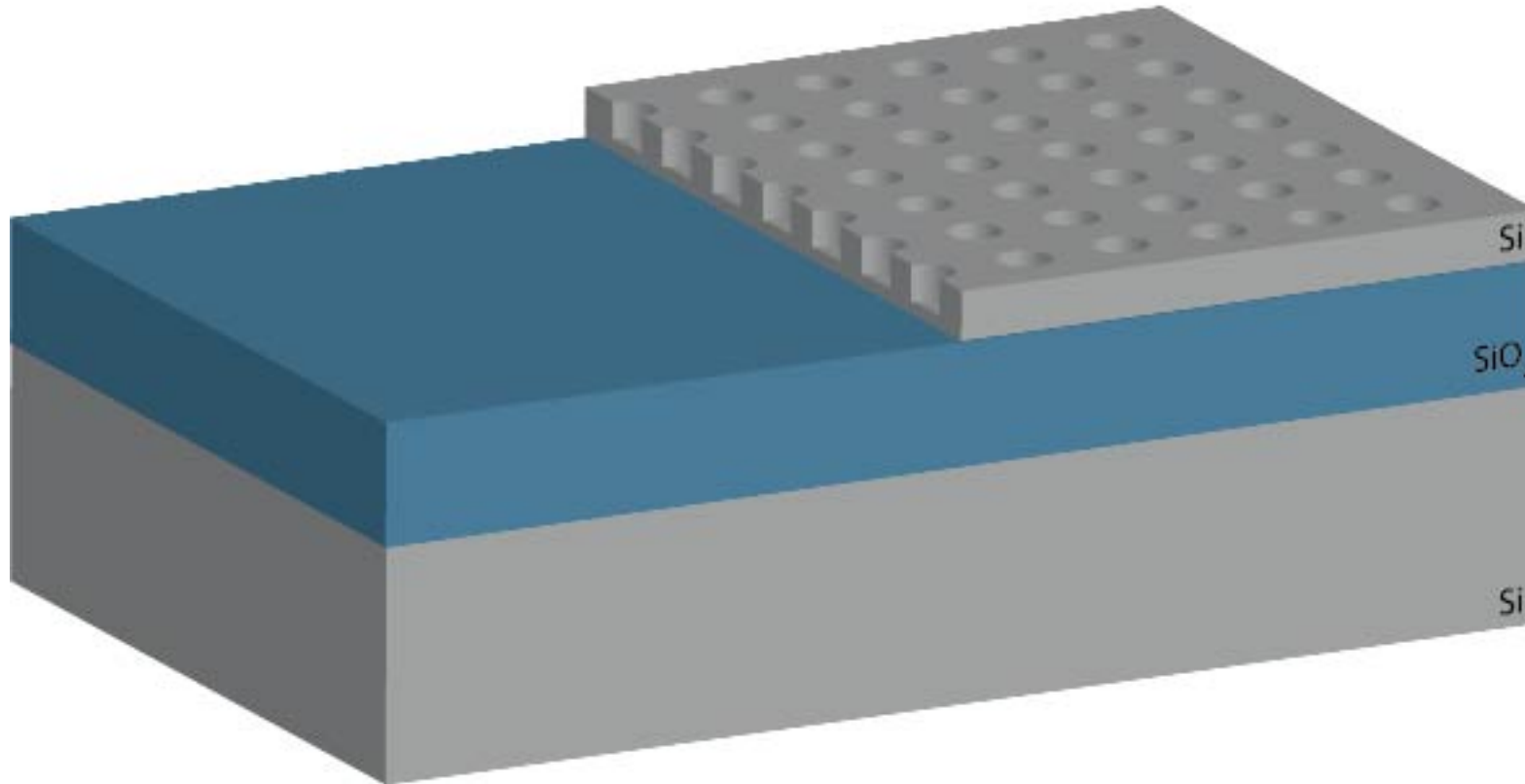
Etch Depth



Etch Depth



Etch Depth



Cross Section:

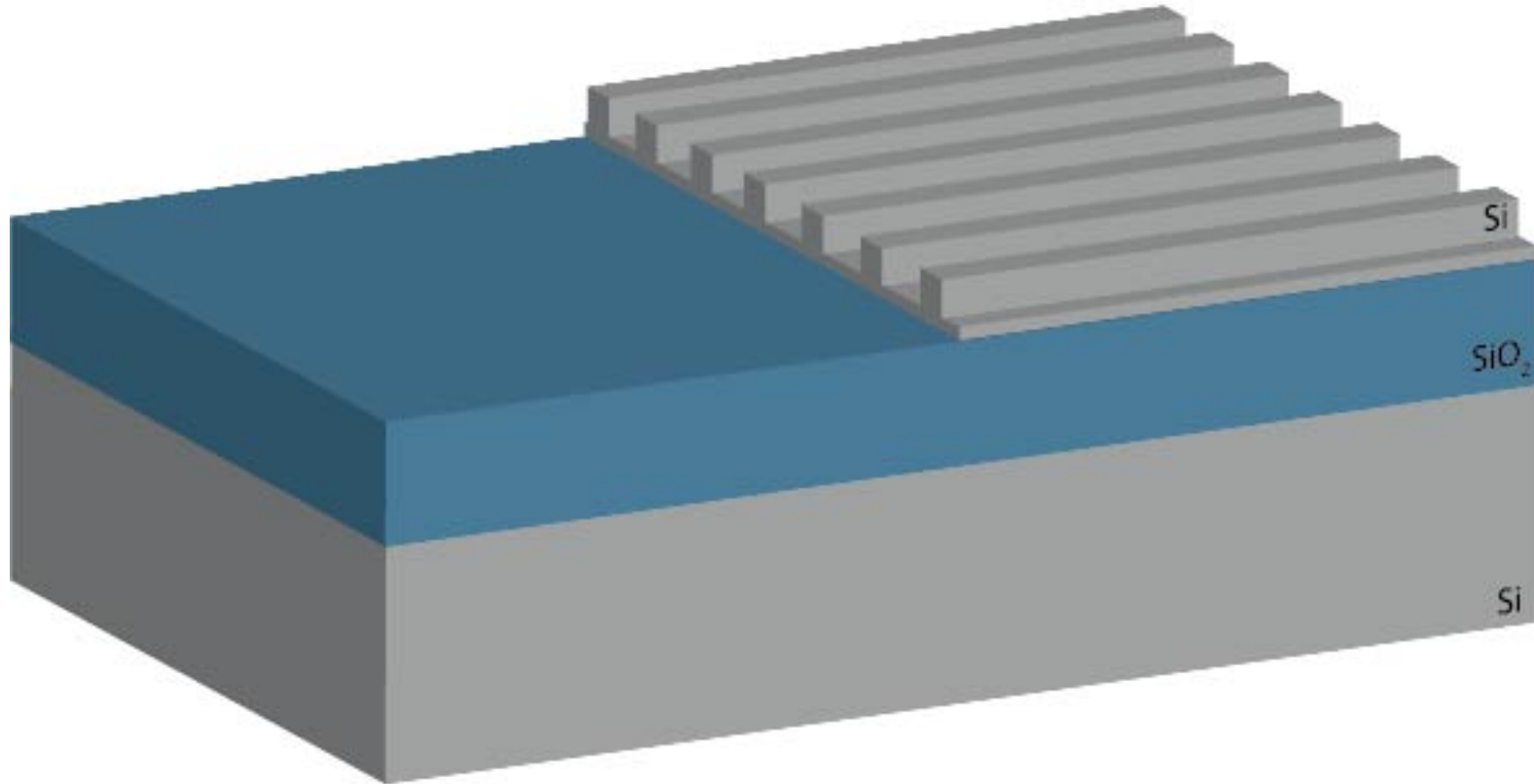


BACKGROUND

FABRICATION

CHARACTERIZATION

Etch Depth



Cross Section:



BACKGROUND

FABRICATION

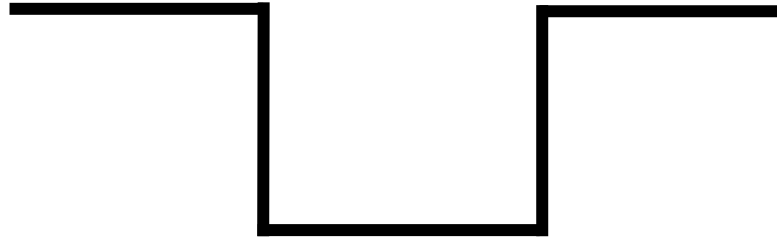
CHARACTERIZATION

What is causing the wavelength shift?

- ~~1. Thickness of Si Device Layer~~
2. Etch Depth
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Sidewall Profile

Model

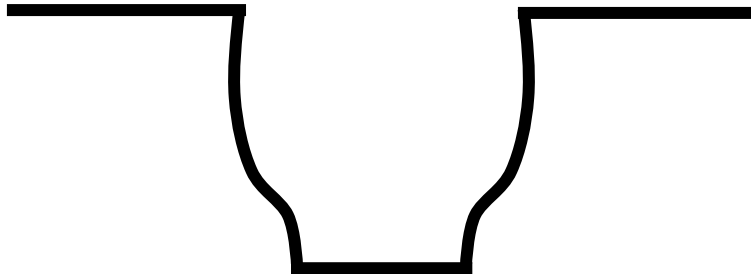


Sidewall Profile

Model



RIE 8



BACKGROUND

FABRICATION

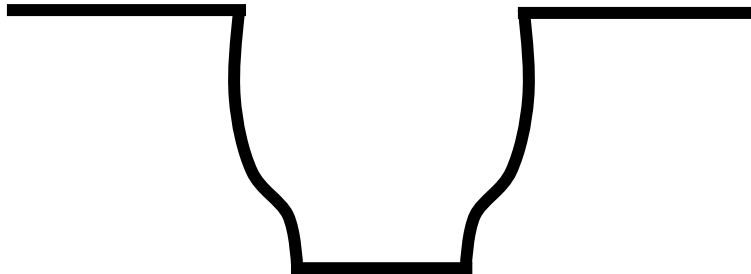
CHARACTERIZATION

Sidewall Profile

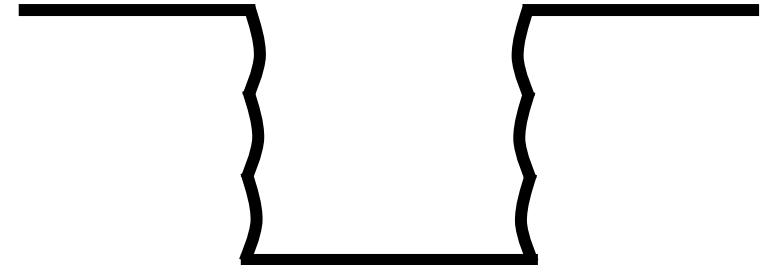
Model



RIE 8



RIE 10

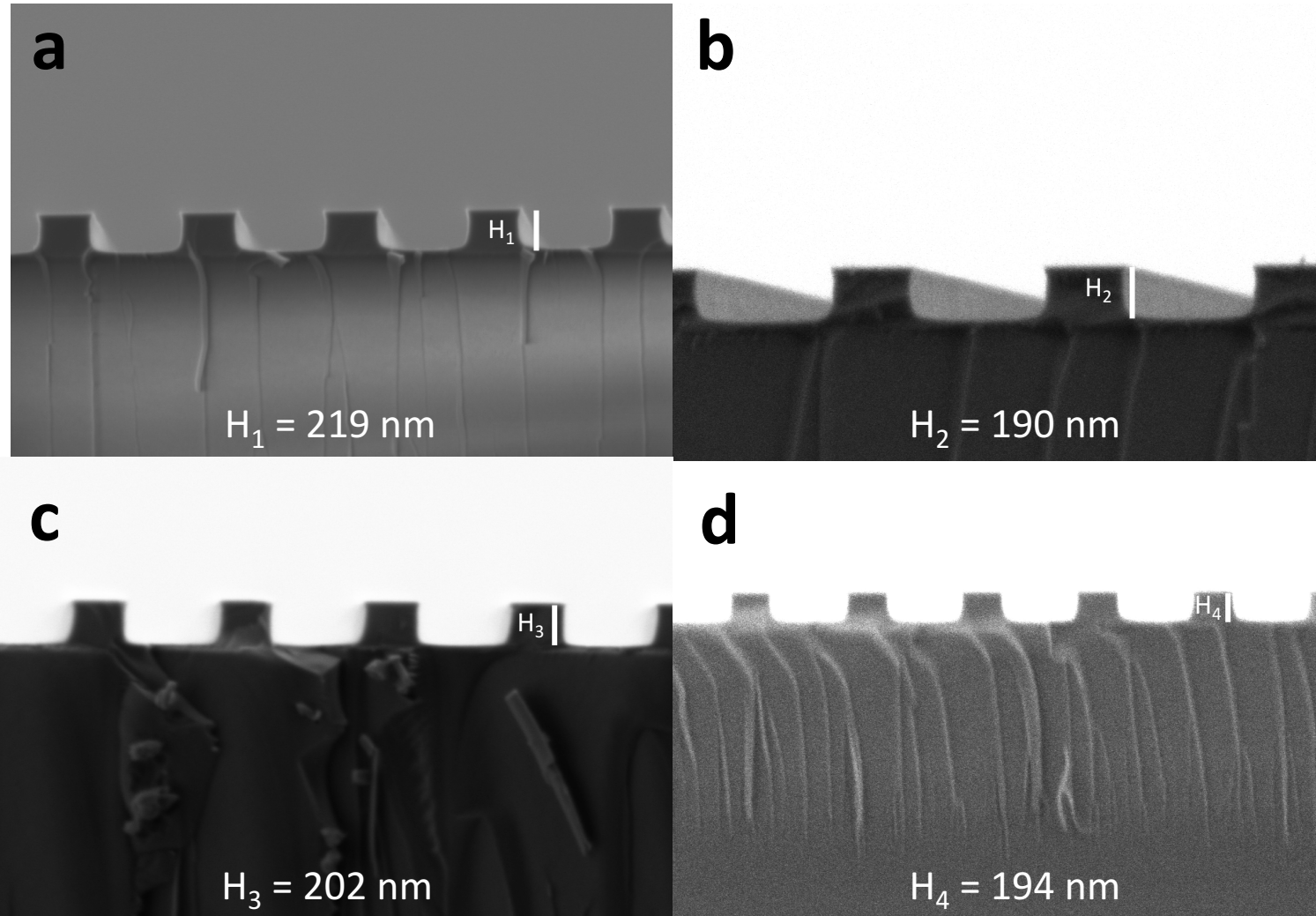


BACKGROUND

FABRICATION

CHARACTERIZATION

Sidewall Profile

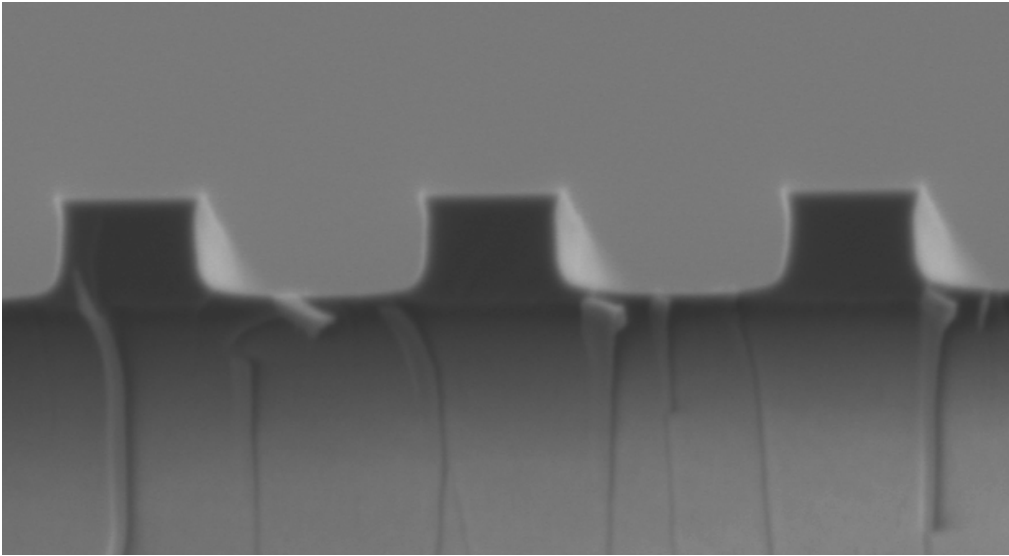


BACKGROUND

FABRICATION

CHARACTERIZATION

Sidewall Profile



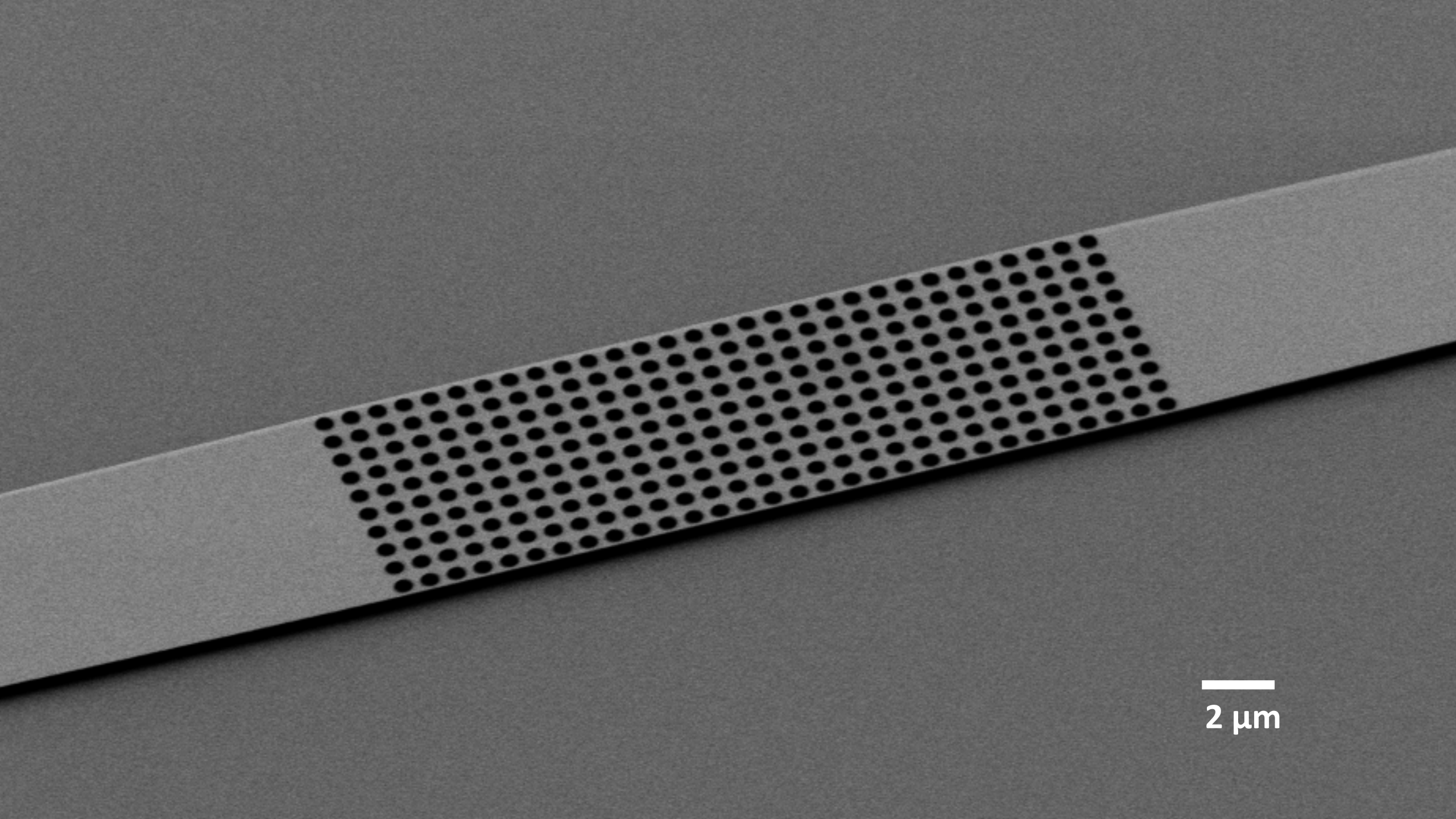
BACKGROUND

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2 μm

Thank you!



HARVARD
John A. Paulson
School of Engineering
and Applied Sciences



National
Nanotechnology
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