

Grating Fabrication on Polymer Waveguide

Student: Ying Wan

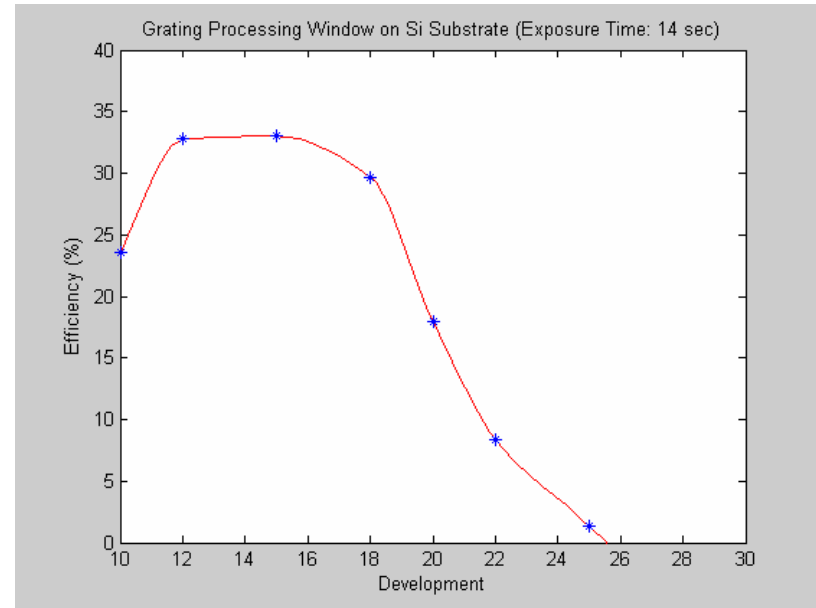
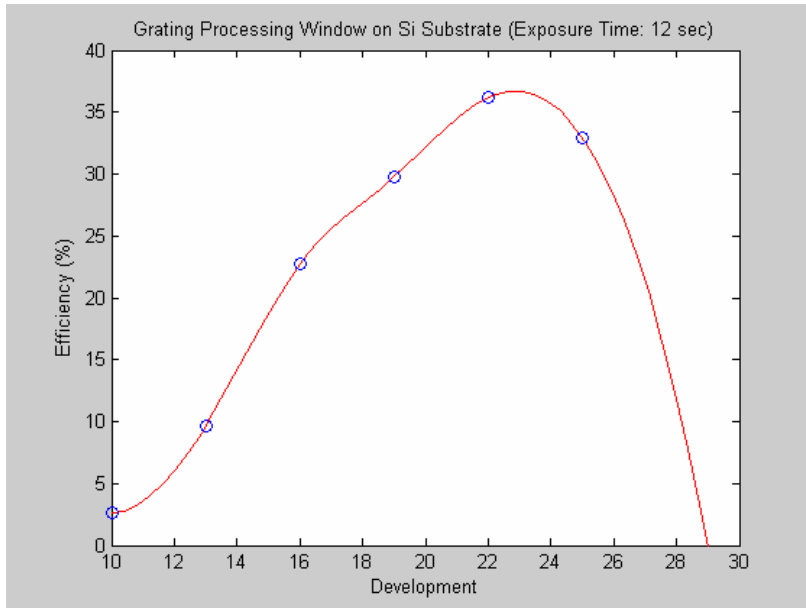
Advisor: Dr. Jerome K. Butler

Grating Design

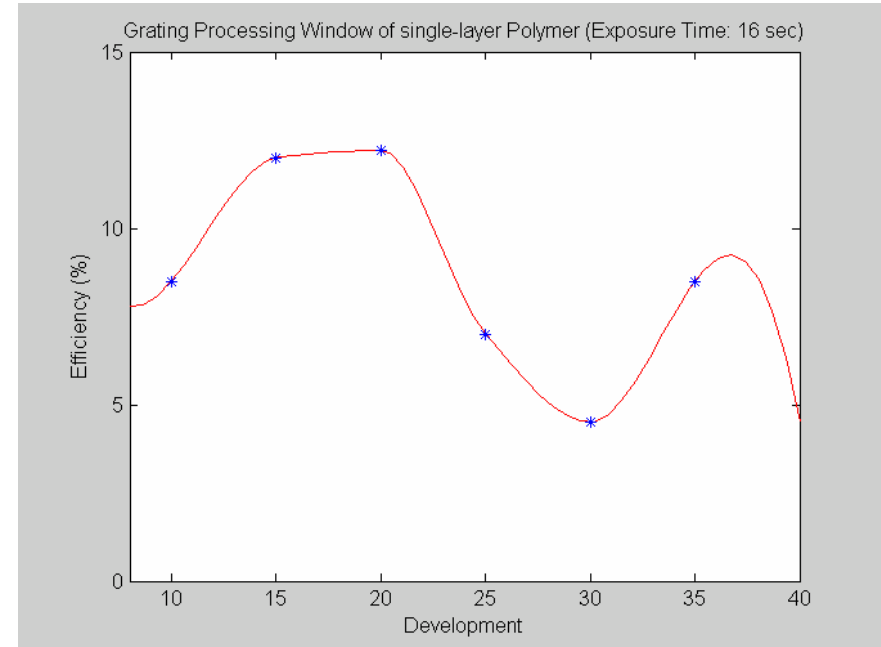
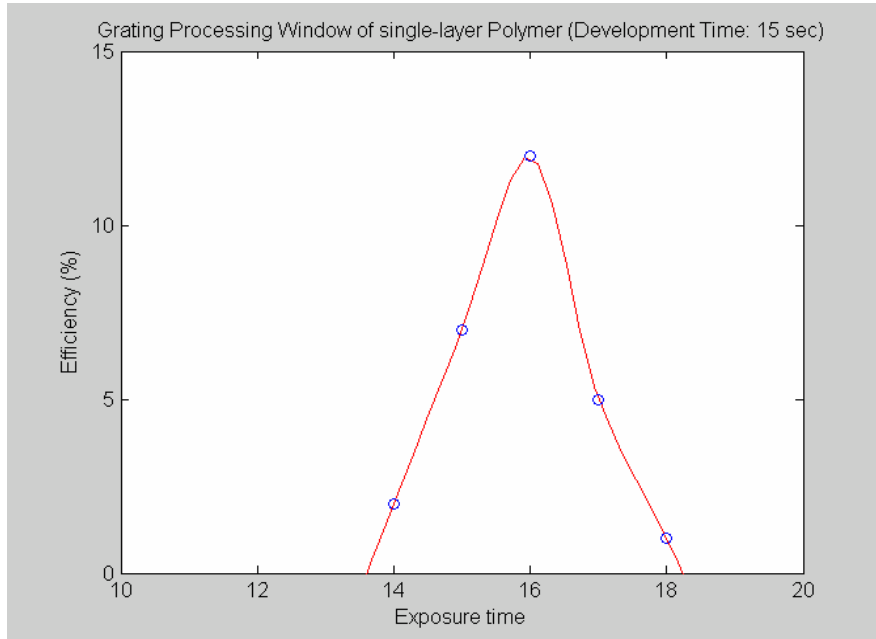
- Grating on 1-layer polymer film
- Grating on 3-layer polymer waveguide
- Grating between 2 polymer waveguide
- Design under visible wavelength ($\lambda = 6328\text{\AA}$)

Type	Zen's 1-layer	Zen's 3-layer	Clemson's 3-layer
Effective Index	1.5012~1.5062	1.5270	1.5037~1.4991
Period (\AA)	4215~4201	4144	4208~4221

Grating Fabrication Window (Si)



Grating Fabrication Window (Poly)



Development time = 15 sec
expose time

14	2
15	7
16	12
17	5
18	1

Exposure time = 16 sec
development

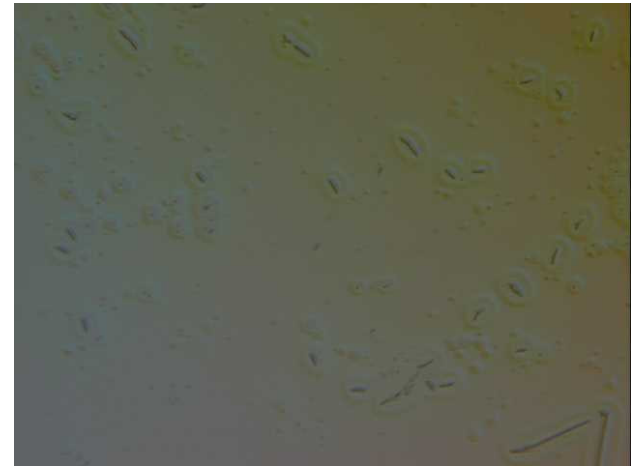
10	8.5		
15	12	0.4	7
20	12.2	8.8	
25	7	0.6	
30	4.5	0.5	
35	8.5		

Problem 1: Tooth Depth

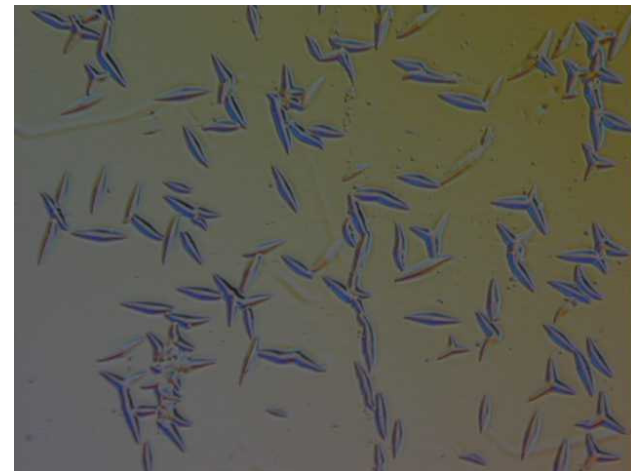
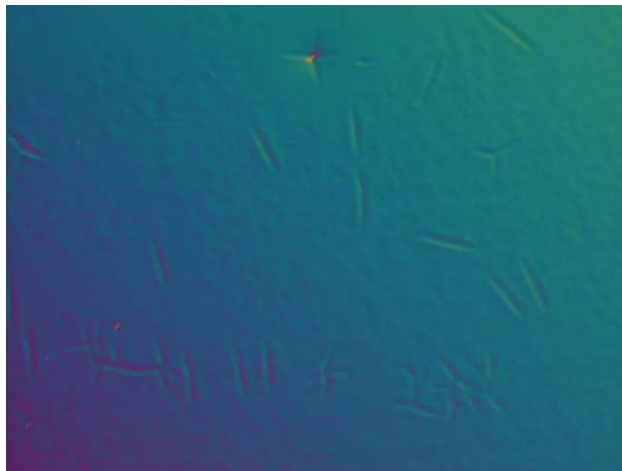
- Photoresist: thickness = 890\AA
- Dry Etching:
 - O₂: Polymer: $900\text{\AA}/\text{min}$; Photoresist: $750\text{\AA}/\text{min}$
 - CF₄: Polymer: $625\text{\AA}/\text{min}$; Photoresist: $400\text{\AA}/\text{min}$
- Solution: metal mask (Ti, Ni) ?

Ti mask: before and after cleaning

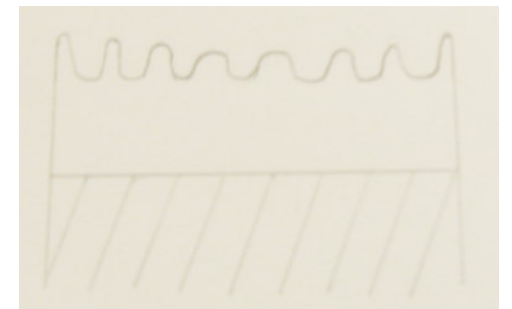
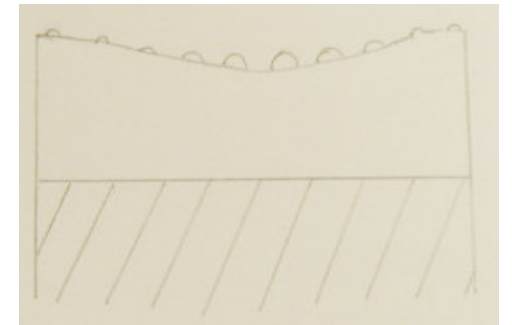
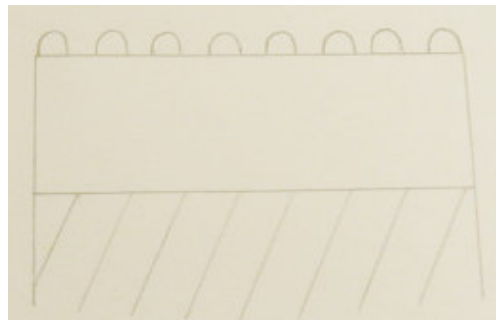
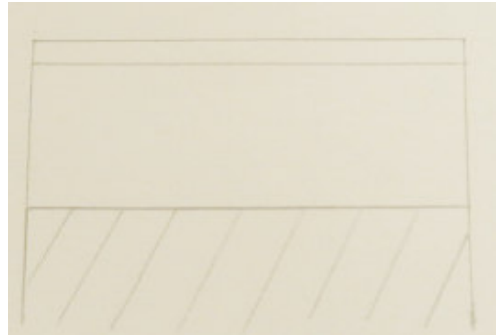
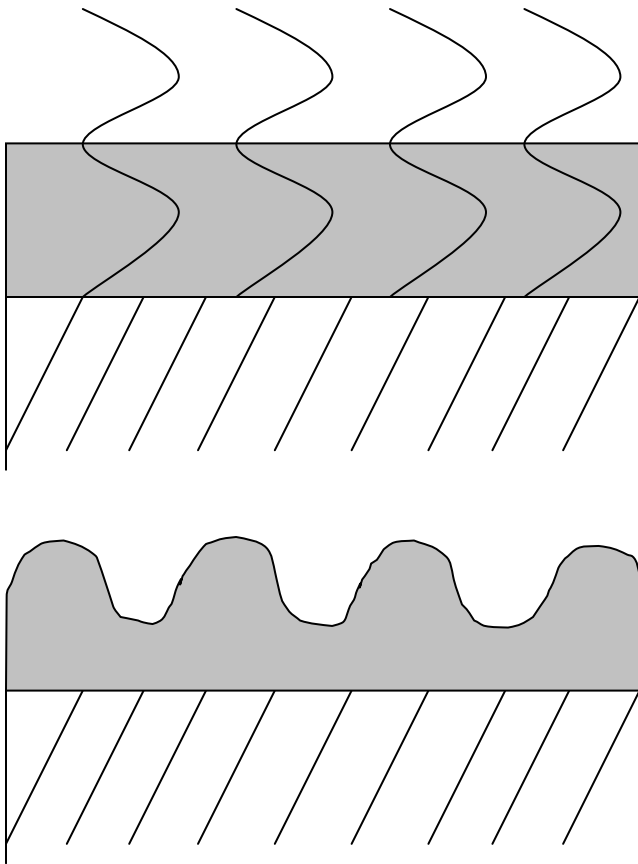
- 1-layer



- 3-layer

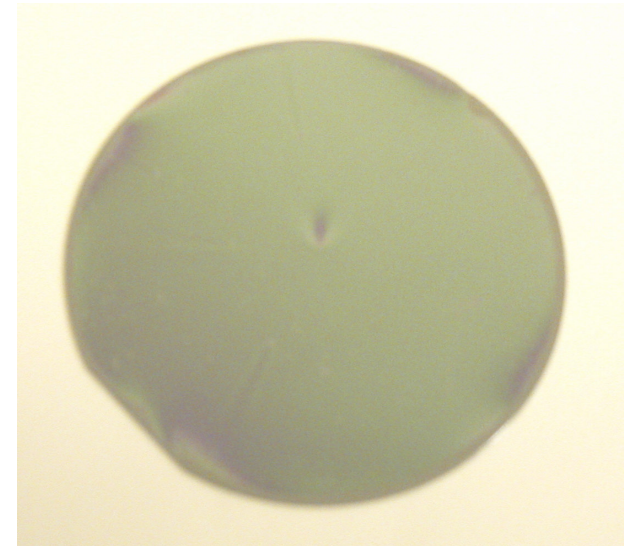
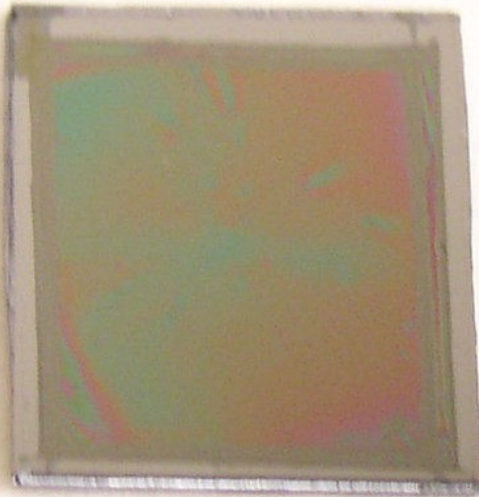
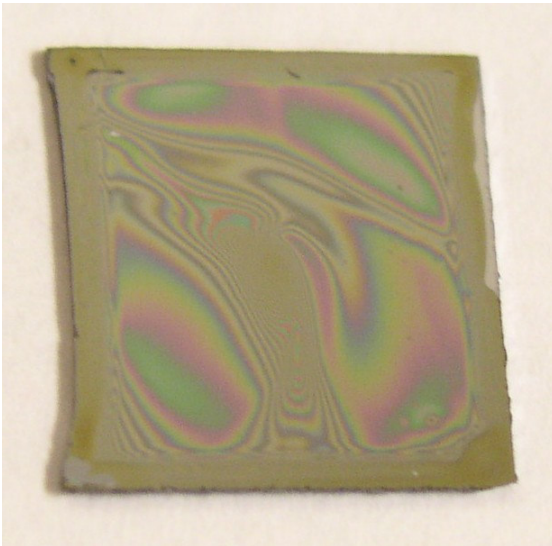


Problem 2: Duty Cycle



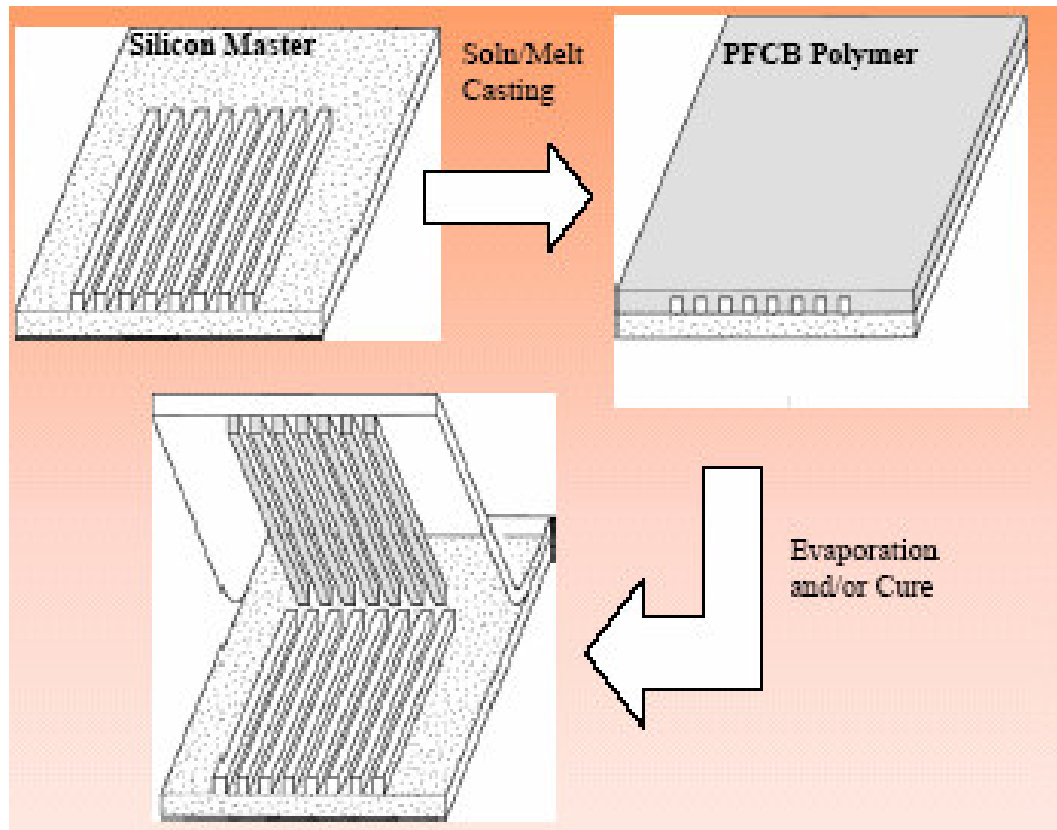
Solution 1 for Duty Cycle

- More uniform surface
 - Because of constructive interference, color distribution exhibits the surface uniformity



Solution 2 for Duty Cycle

- Silicon Master



Shah, H.; Smith, Jr., D.W. et al. *IEEE Photonic Tech. Let.* **2000**, 12(12), 1650.