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Coupling light to periodic nanostructures

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APPENDIX

APPENDIX A

Fabrication recipe for photonic-crystal slabs

In this appendix we summarize the fabrication process for the AlGaAs photonic-crystal slabs in this thesis.

A.1 Wafer preparation

Material:

SiN_x	150 nm	Etch mask
GaAs	100 nm	Protective capping layer
$\text{Al}_{0.35}\text{Ga}_{0.65}\text{As}$	150 nm	Photonic-crystal layer
$\text{Al}_{0.7}\text{Ga}_{0.3}\text{As}$	1000 nm	Sacrificial layer
GaAs	$\sim 200 \mu\text{m}$	Wafer

Cleaning:

- Acetone, 50°, 5'
- Iso-propyl alcohol, rinse
- N_2 (g), dry

Resist application:

- Resist: ZEP 520A
- Spin coating, 1500 rpm, 60" (gives ~ 500 nm thickness)
- Bake, 175°, 30'

A.2 Mask definition

Exposure:

- Positive-tone pattern
- Resolution: 10 nm
- Dose: 220-260 $\mu\text{C}/\text{cm}^2$
- Spot size: ~ 8 nm

Development:

- *n*-amyl acetate, 80"
- 9:1 Methyl Isobutyl Ketone:Iso-propyl alcohol, 30"
- N₂ (g), dry

Transfer to silicon nitride:

- RIE etch
- 25 sccm CHF₃, 25 sccm Ar
- Power: 50 W
- Pressure: ~ 8 μbar
- Etch speed: ~ 15 nm/min
- Selectivity: $> 1 : 10$
- Stop monitored with interferometer

Resist removal:

- RIE etch
- 20 sccm O₂
- Power: 50 W
- Pressure: ~ 4 μbar
- Etch speed: > 100 nm/min

A.3 Pattern transfer

RIE etch:

- 15 sccm BCl₃, 7.5 sccm Cl₂, 10 sccm N₂
- Power: 100 W
- Pressure: ~ 4 μbar
- Etch speed: > 200 nm/min for GaAs, changes with Al concentration
- Selectivity: > 10 , changes with Al concentration

A.4 Mask removal

SiN_x removal:

- RIE etch
- 25 sccm CHF₃, 25 sccm Ar
- Power: 50 W
- Pressure: $\sim 8 \mu\text{bar}$
- Etch speed: $\sim 15 \text{ nm/min}$
- Stop monitored with interferometer

GaAs capping layer removal:

- 4:1 Citric acid (50 wt%):H₂O₂ (40% solution), 1'
- H₂O, stop, 30"

A.5 Membrane formation

Sacrificial layer etch:

- 1:4 HF (40%):H₂O, 1'
- H₂O, stop, 30"
- iso-propyl alcohol, rinse
- dry with critical point dryer

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