

High-Frequency Ultrasonic Detector Using Photonic Crystal

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Introduction

The team developed an ultrasonic detector using Photonic Crystal (PC) that has larger bandwidth and higher sensitivity, due to the limitation of traditional detecting device. A photonic crystal sensor (PC sensor) is illuminated with laser beam. The wavelength of laser is identical with resonance of PC sensor, resulting high reflection efficiency. The resonant wavelength shifts due to the acoustic wave applied upon the PC surface. The intensity of the reflected light decreases and is thus determined by photo detector.

Design Requirement

Functional Requirement

- ✓ Laser diode
- ✓ Photonic crystal sensor
- ✓ Acoustic wave transducer
- ✓ Photodetector
- ✓ Oscilloscope
- ✓ Sample holder
- ✓ Beam splitter

Non-Functional Requirement

- ✓ Cost under \$2000
 - ✓ Fast and easy to use
- Operating Environment
- ✓ Sensor must be covered in specific index liquid according to the wavelength of laser

Advantages

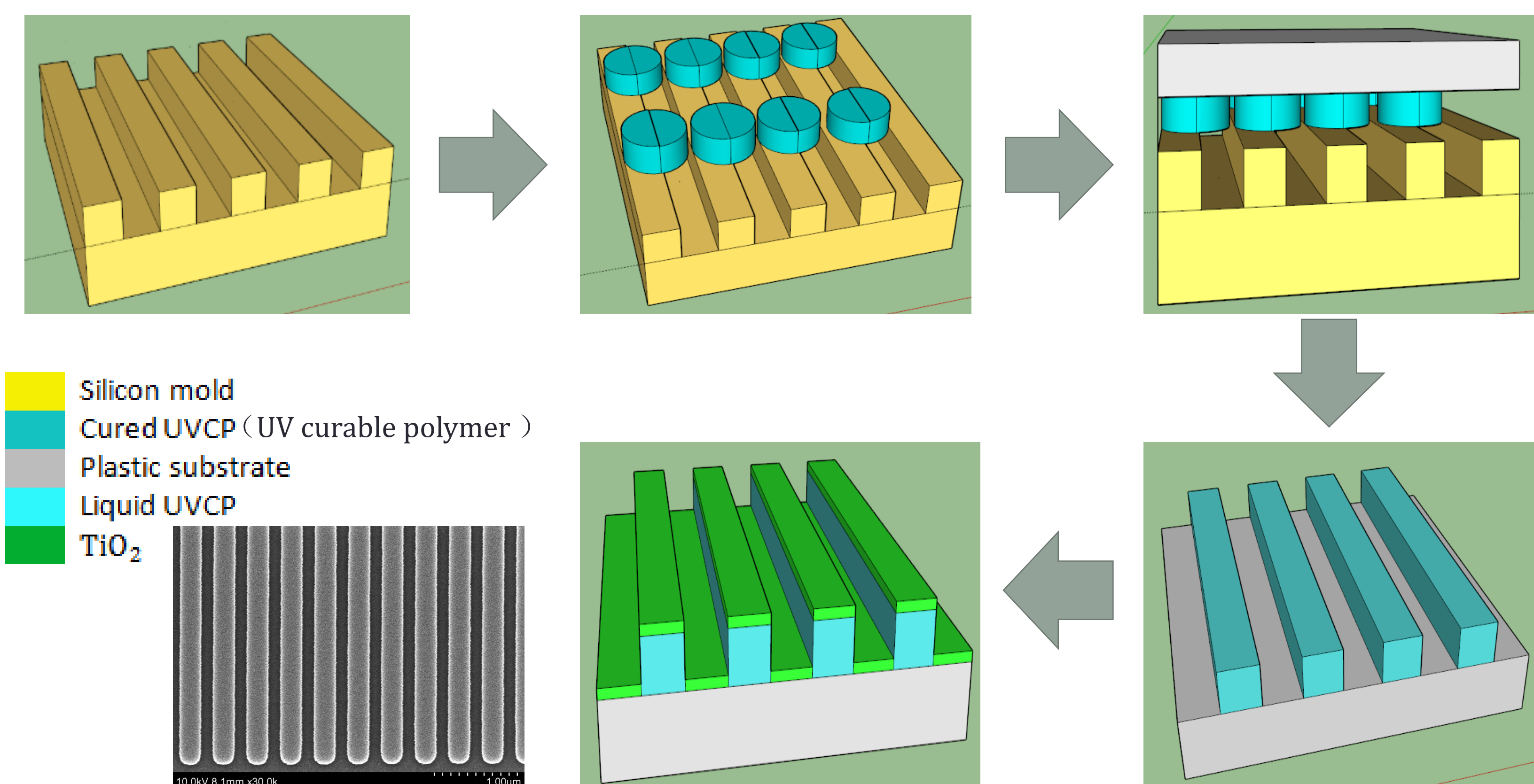
- ✓ Higher sensitivity
- ✓ Large bandwidth
- ✓ Fast response time
- ✓ Lower cost
- ✓ Smaller size

Application

- ✓ High resolution image technology
- ✓ Medical usage

Photonic Crystal

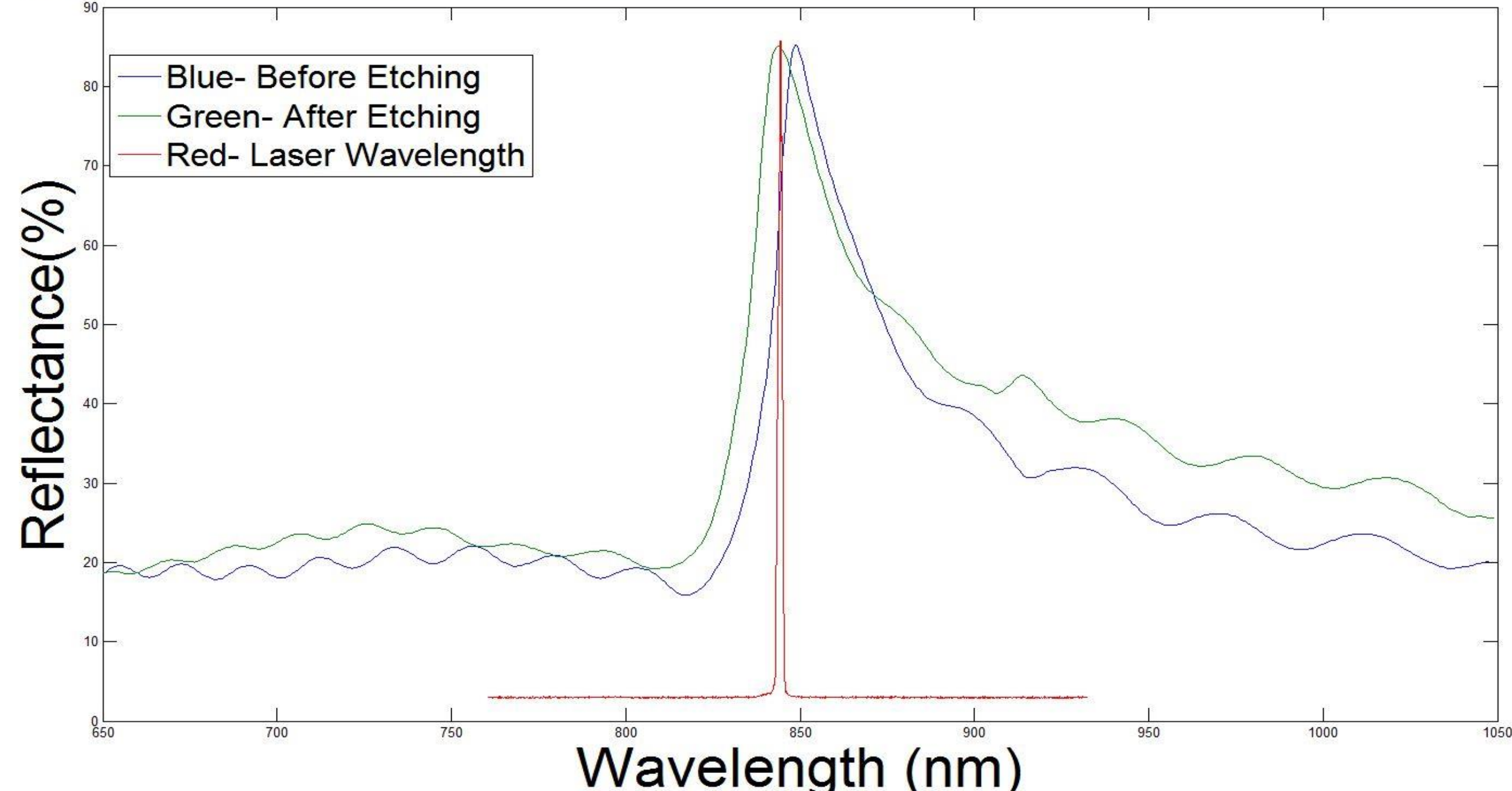
Fabrication Process



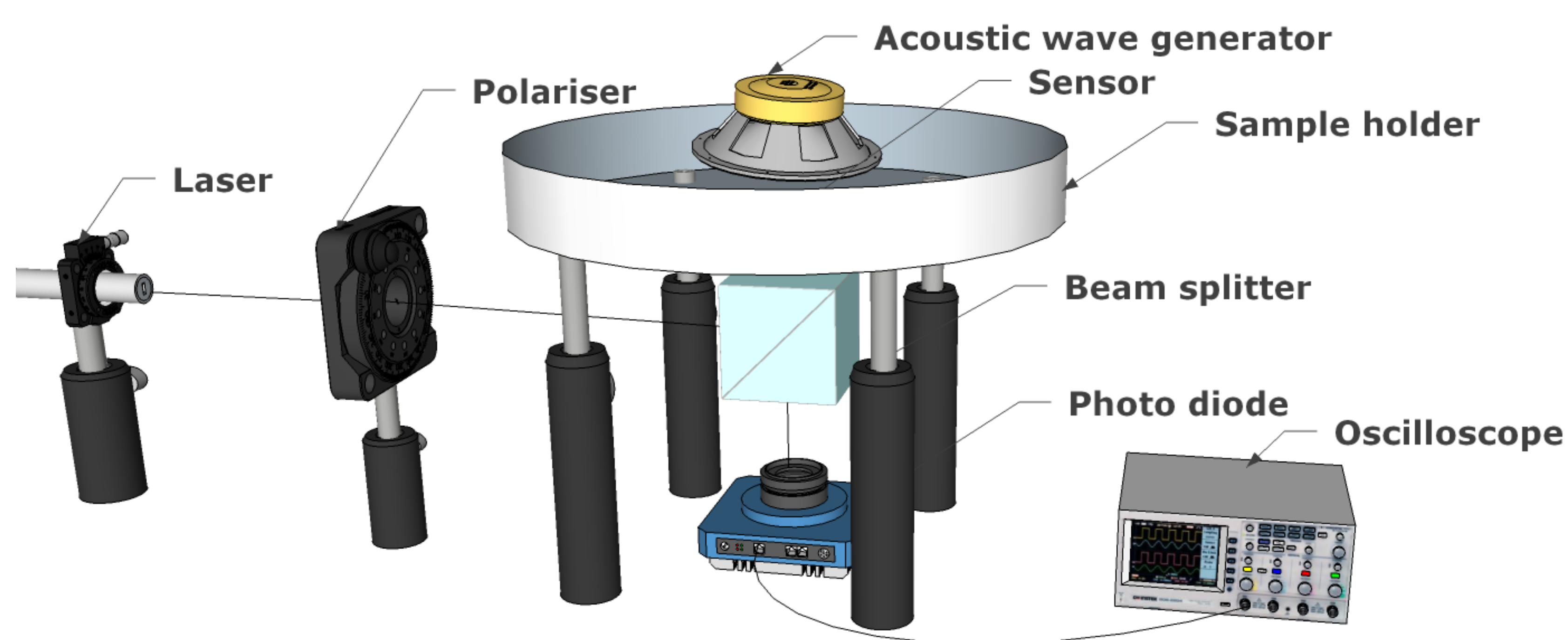
Etching Process & Results

The resonant wavelength can be adjusted with the thickness of TiO₂, which can be achieved by etching the top layer in correct time.

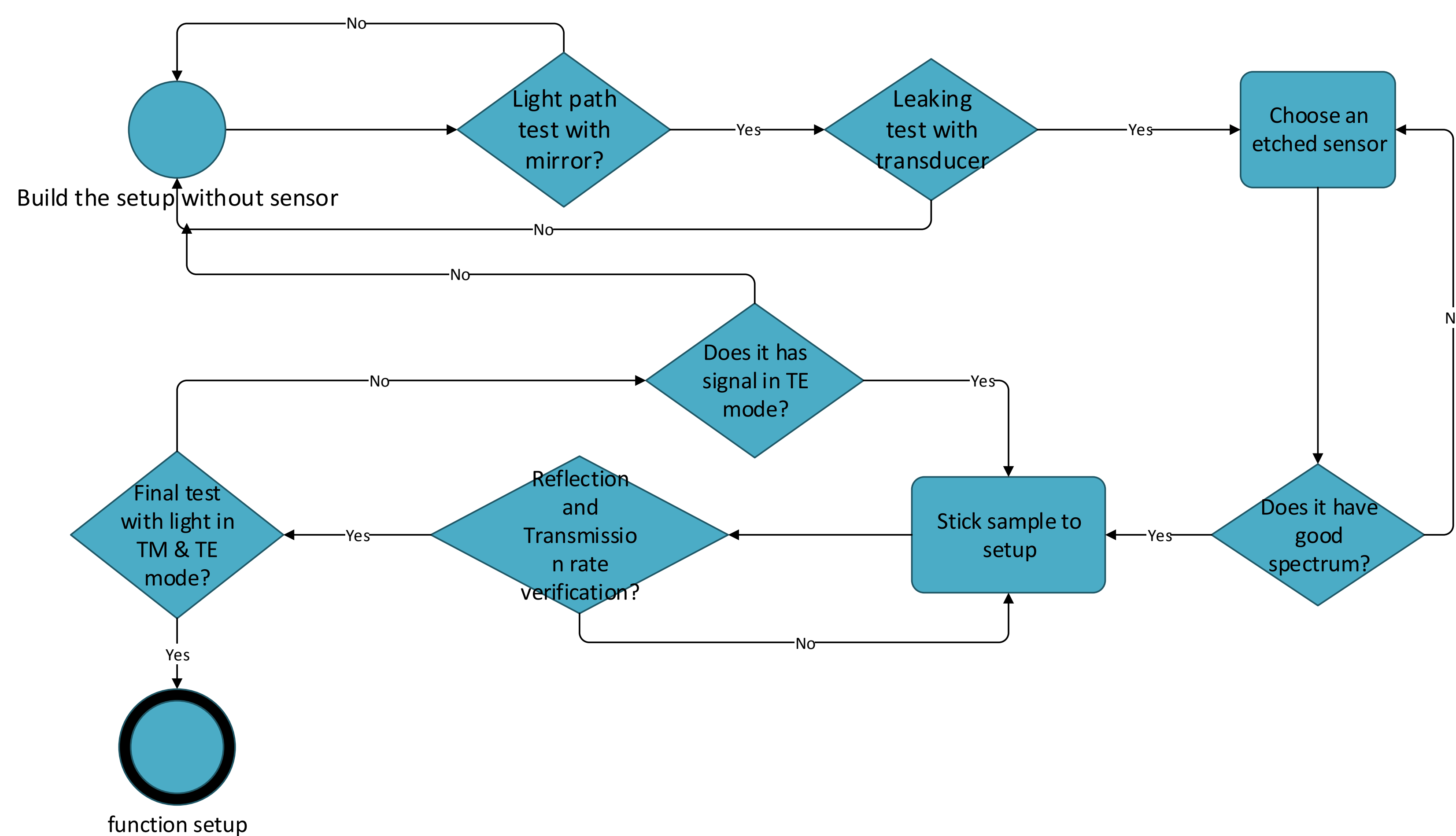
Shifting Resonant Wavelength to Laser Wavelength by Accoustic Wave



Optical Setup



Testing



Results

- Use waveform of the transducer (40KHz) as a reference.
- Output result with laser in TM Mode.
- Output result with laser in TE Mode.

Ultrasound detector result with reference

