

## Background

Traditional infrared (IR) imaging systems rely only on temperature differences for contrast, making target detection difficult when objects and backgrounds are at the same temperature. This motivates polarimetric imaging, which reveals material and surface features invisible to conventional imaging. Polarimetric infrared sensing has applications in defense, surveillance, environmental monitoring, and remote sensing.

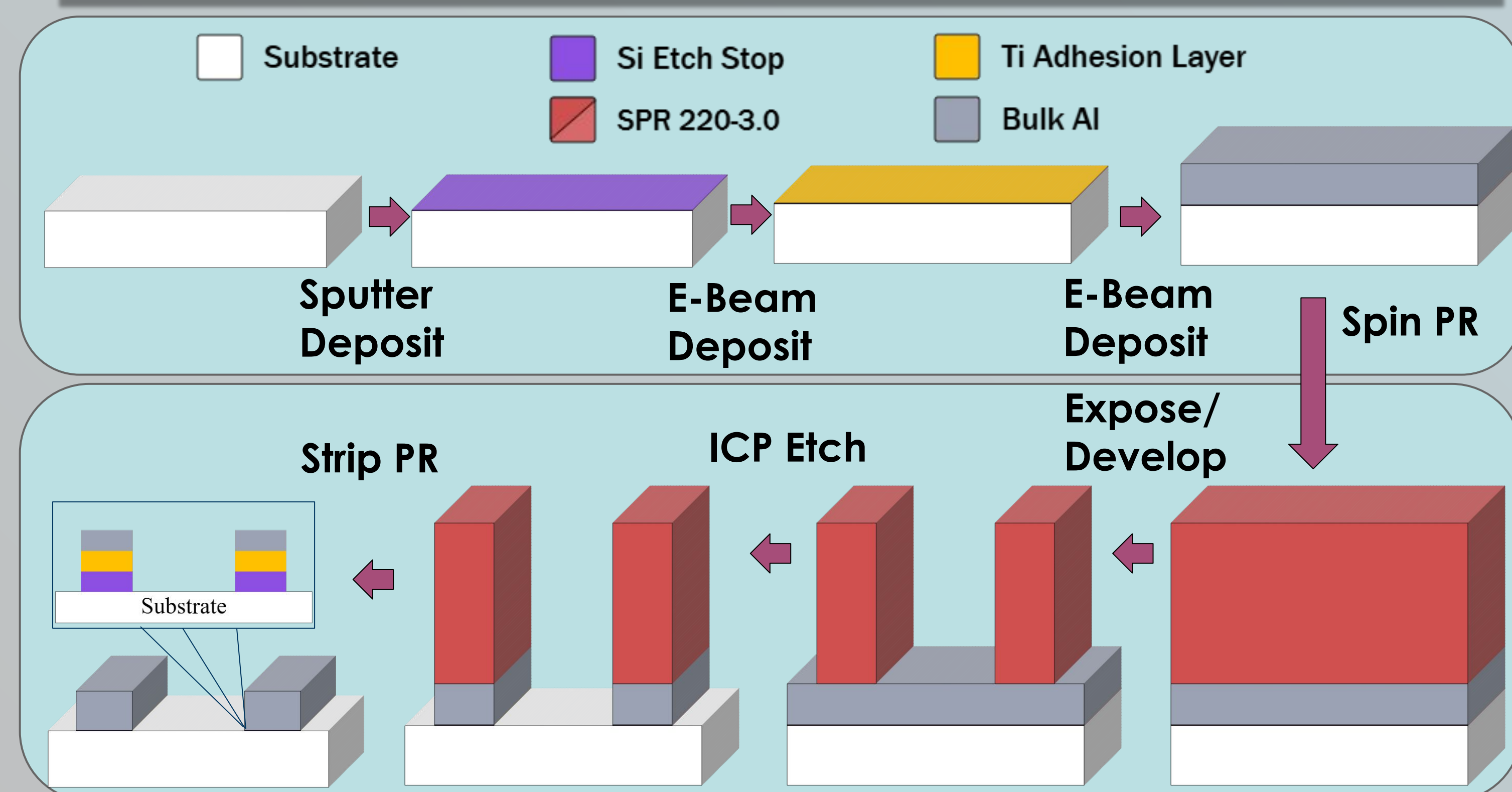
## Overview & Design Specs

This goal of this project was to design and fabricate a metasurface wire-grid polarizer for Long-wave IR (LWIR) polarimetric imaging.

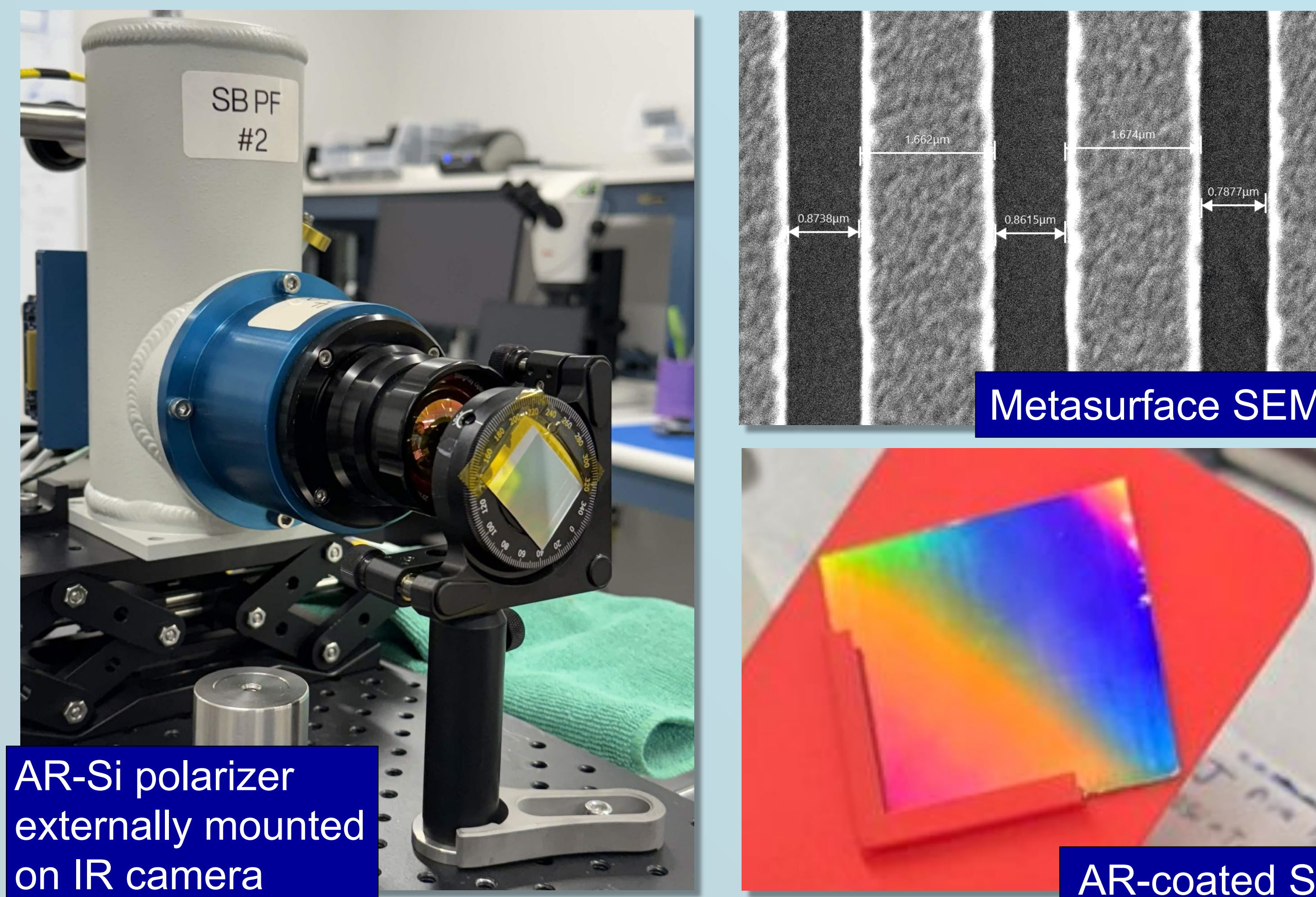
### Key Features

- LWIR (8–14  $\mu\text{m}$ ) polarimetric imaging
- $\mu$ -scale metasurface wire-grid polarizer architecture
- AR-coated Silicon and ZnS substrates
- Cryogenic temperature operation
- Competitive against COTS polarizers

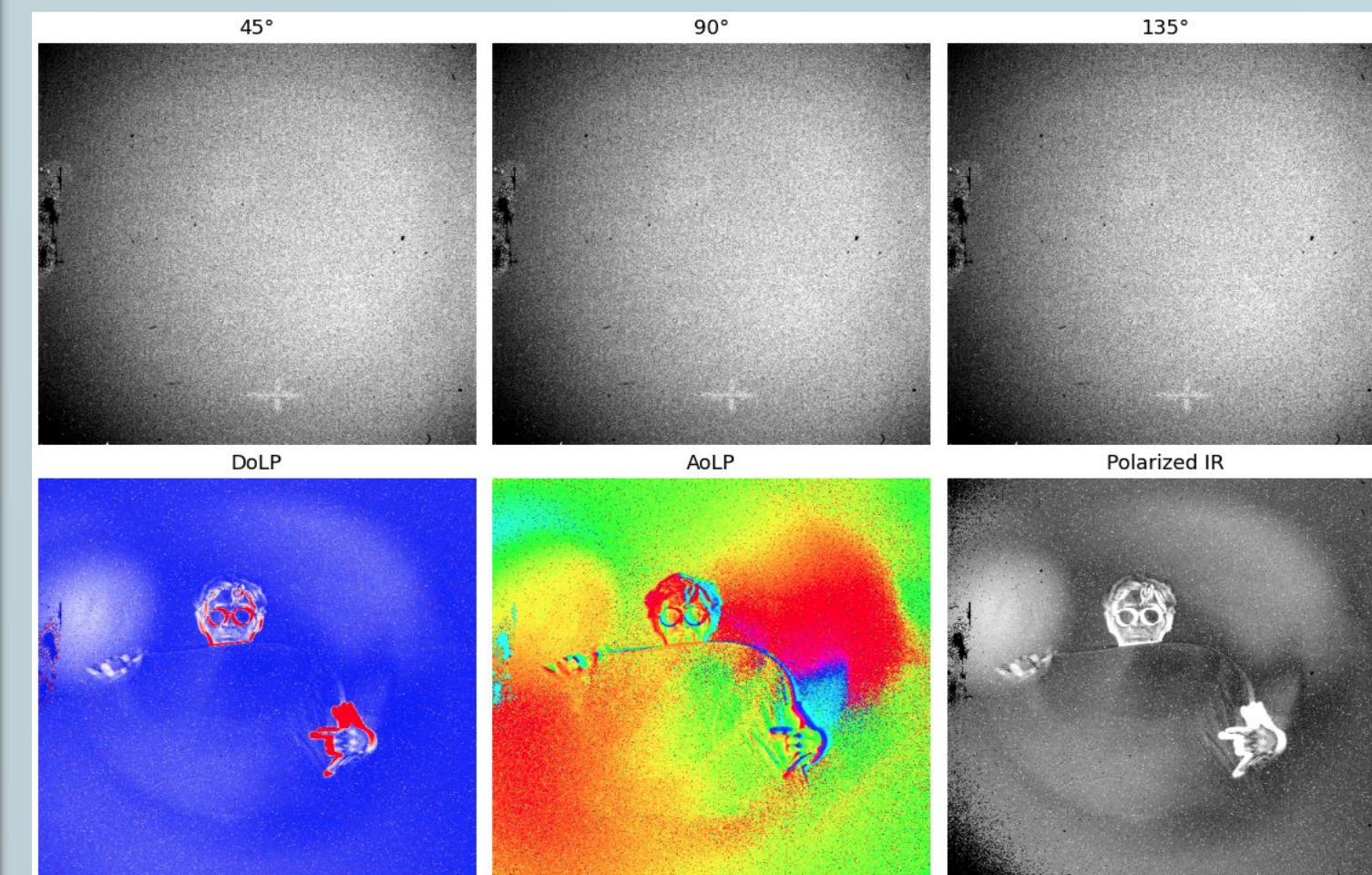
## Fabrication Process



## Eidolon Metasurface IR Polarizer



## Project Workflow



### 1. Proof of Concept

Captured IR images at multiple polarizations and used a Python scripting pipeline to demo project viability.

### 2. Simulations/Optimization

Optimized metasurface wire-grid geometries in Ansys Lumerical using genetic algorithms.

### 3. Fabrication

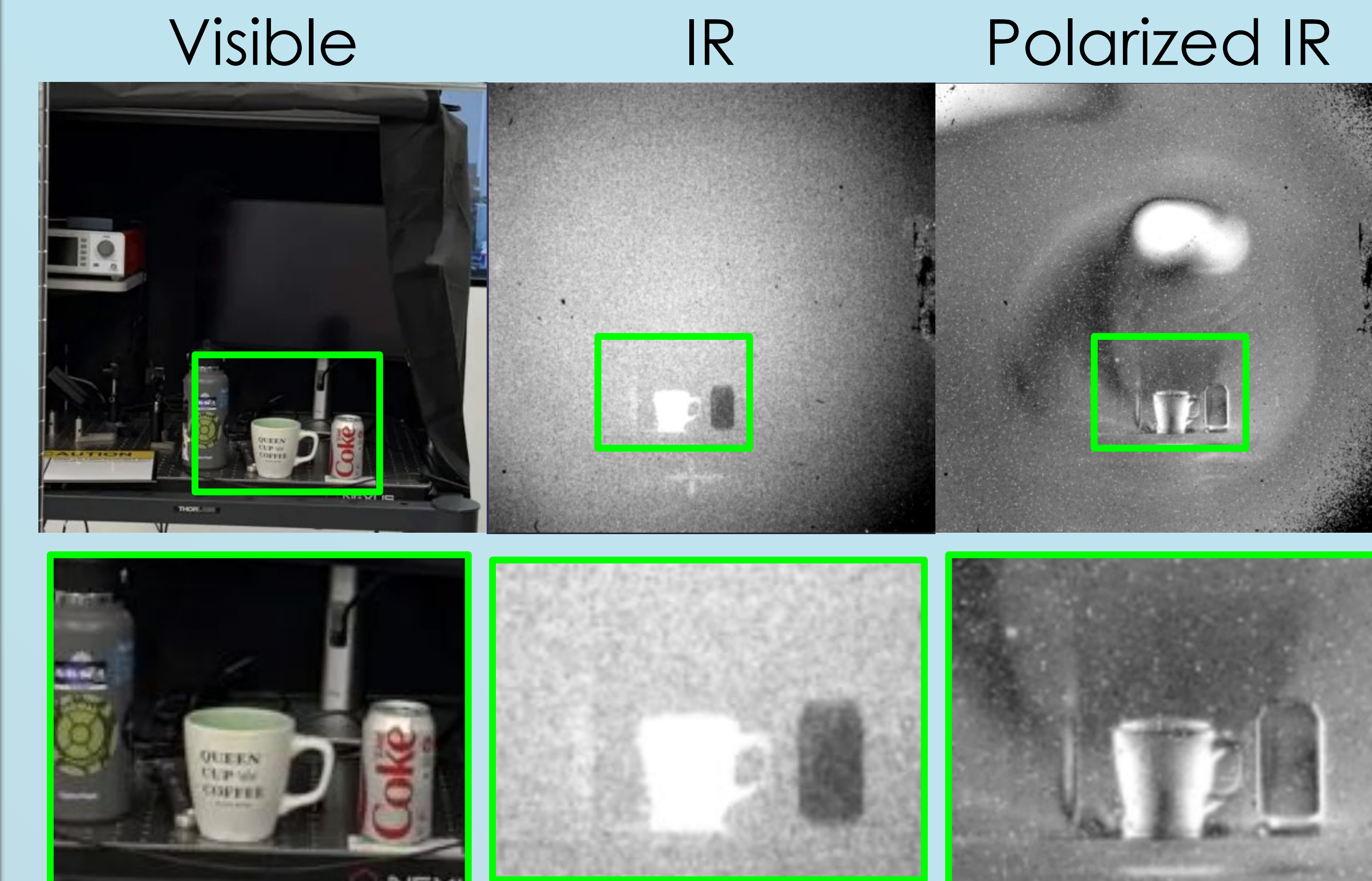
Initial masks and final optimized structures fabricated in UCSB nanofab on AR-coated silicon.

### 4. Characterization

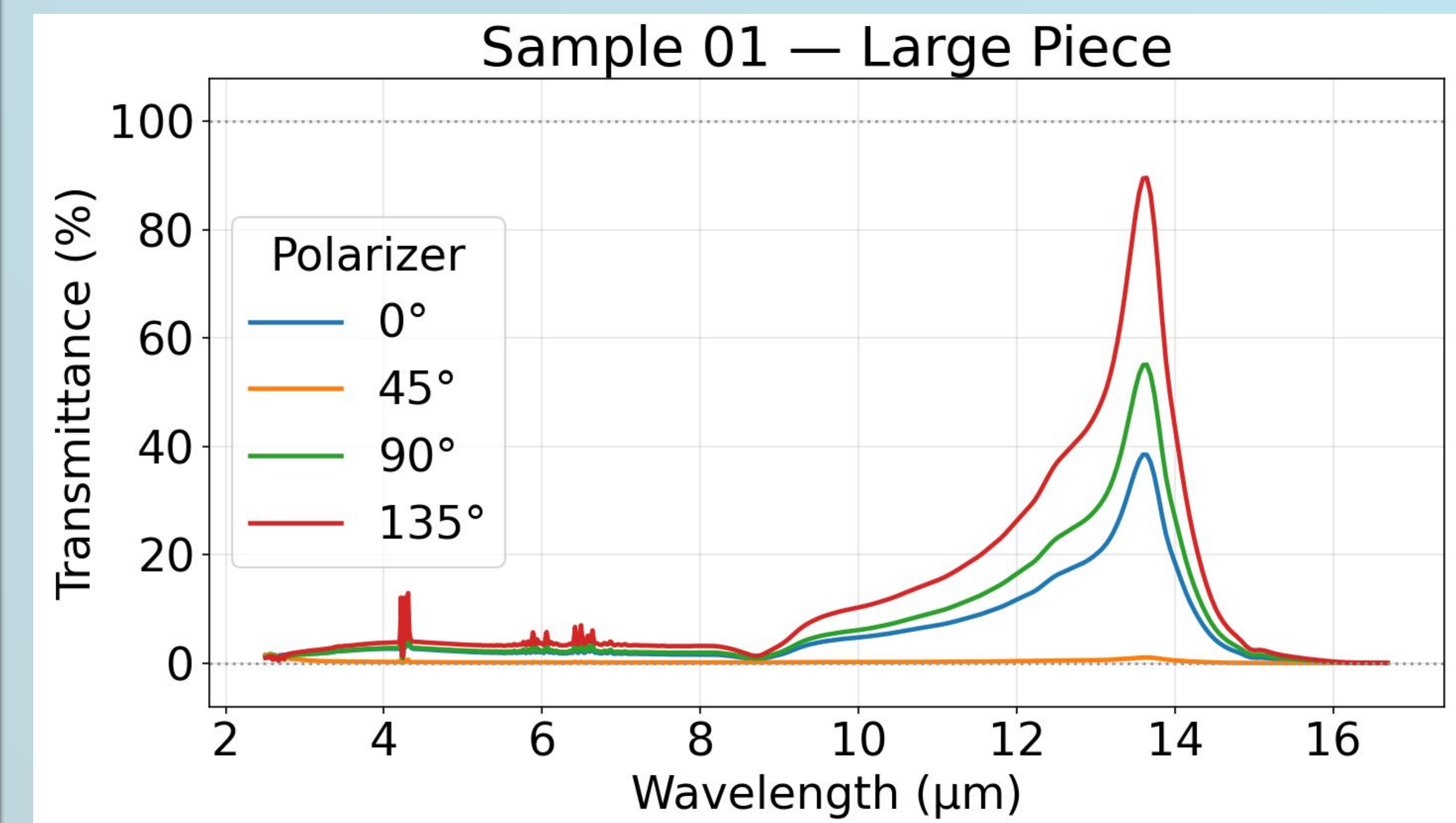
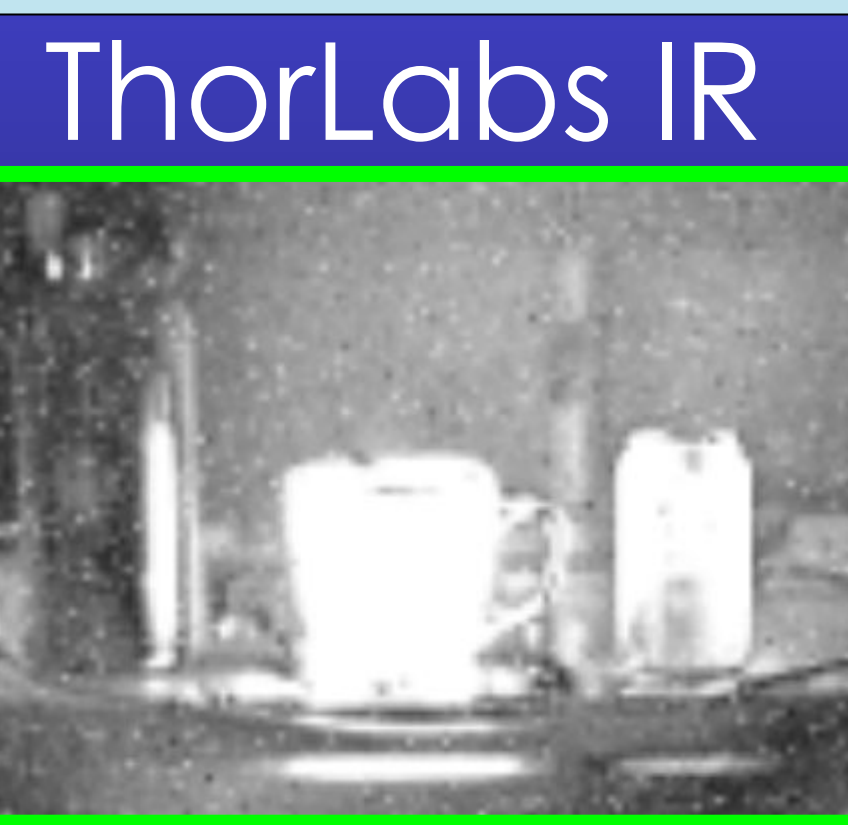
Characterized using FTIR measurements and compared performance against COTS polarizers.



## Thermal vs. Our Polarizer



## Fourier Transform Infrared (FTIR) Spectroscopy Results



- Proven quantitative polarization sensitivity in the long-wave infrared band (8-14 $\mu\text{m}$ )
- Qualitatively, polarization sensitivity is competitive with a \$2500 ThorLabs polarizer

## Acknowledgements:

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