A LOW-COST, RECONFIGURABLE THIN-FILM INSPECTION SYSTEM

TOWARDS LARGE AREA THIN-FILM REFLECTOMETRY

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Photo credit: @bruce.digital

OVERVIEW

- Motivation
  - Challenges
- State of the Art
- Approach
- Status
- Future work

BATTERY CELLS

DISPLAYS

FOOD PACKAGING

SOLAR CELLS

ILLUSTRATION OF INDUSTRIAL THIN-FILM INSPECTION

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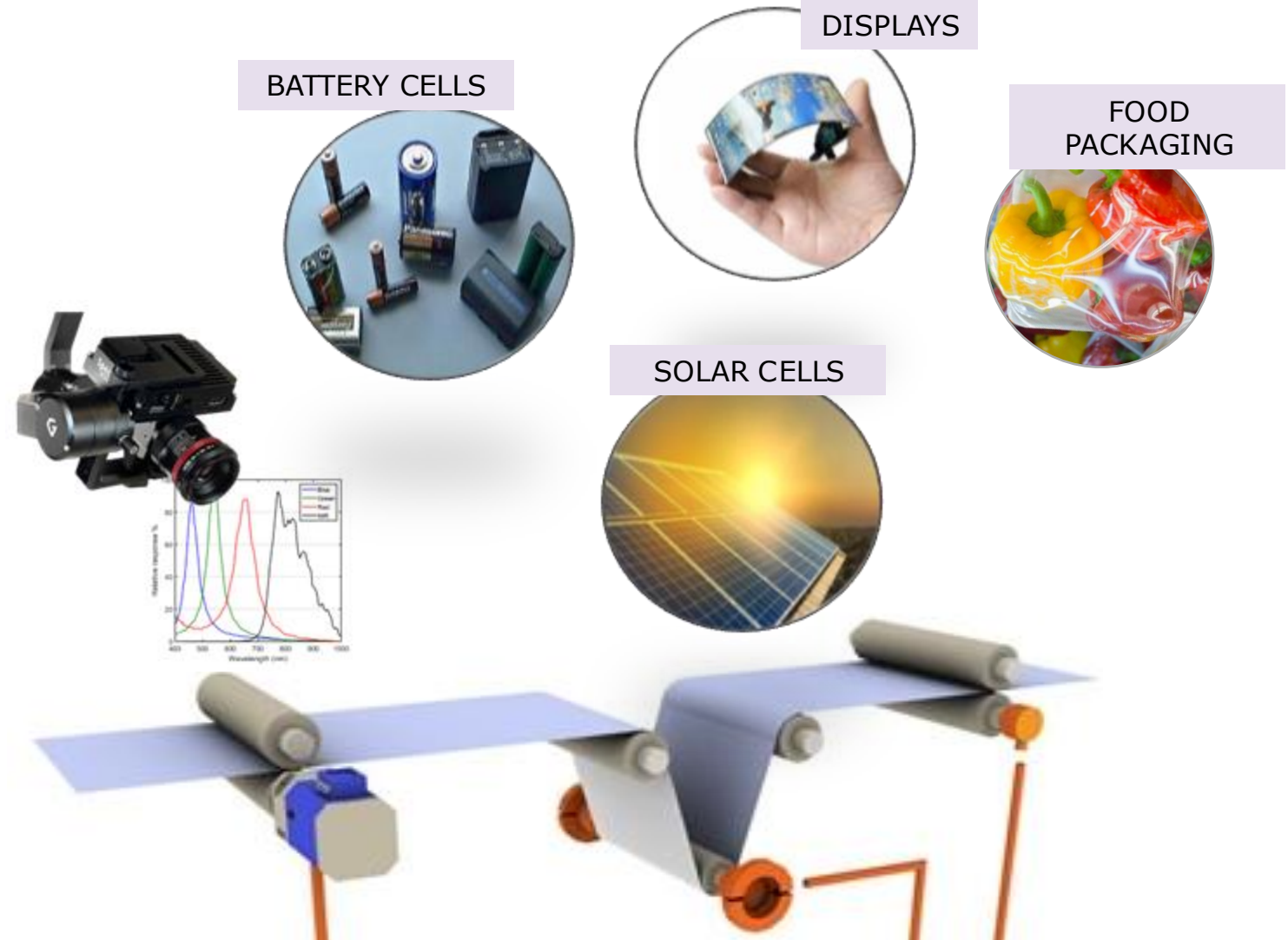
MOTIVATION

- "Metrology has not kept up with thin-film manufacturing speeds" (Maize et al, 2022; NIST 2016)

- Large-area thin films are everywhere!

  - used in PV, displays, batteries, and packaging

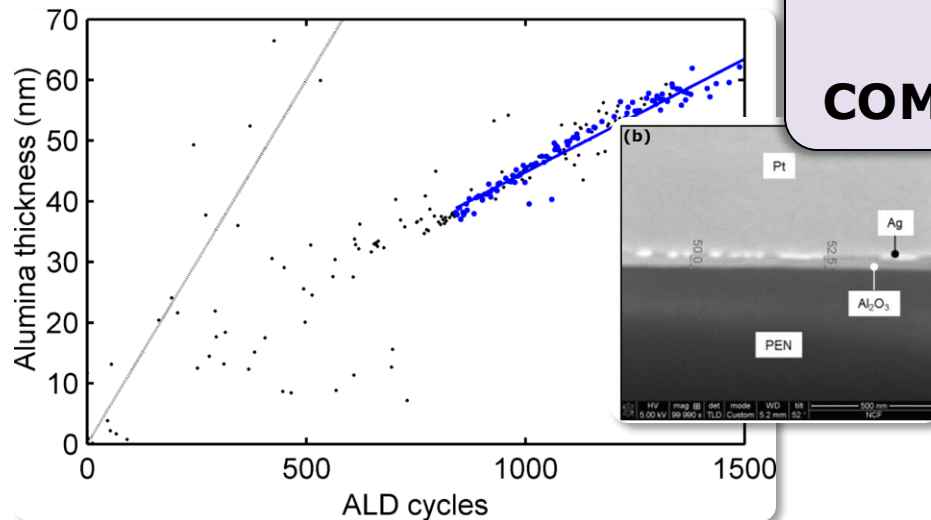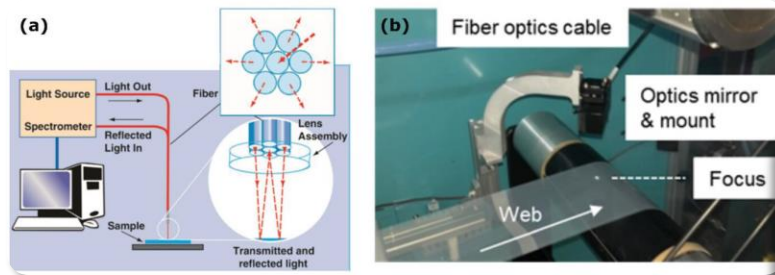- Industry often needs 100% inline, real-time inspection

CHALLENGES

- Metrology is too computationally heavy or too slow

- Also, too expensive

Figure ES-2. Interviewees' Rating of Importance of Technology I[...]
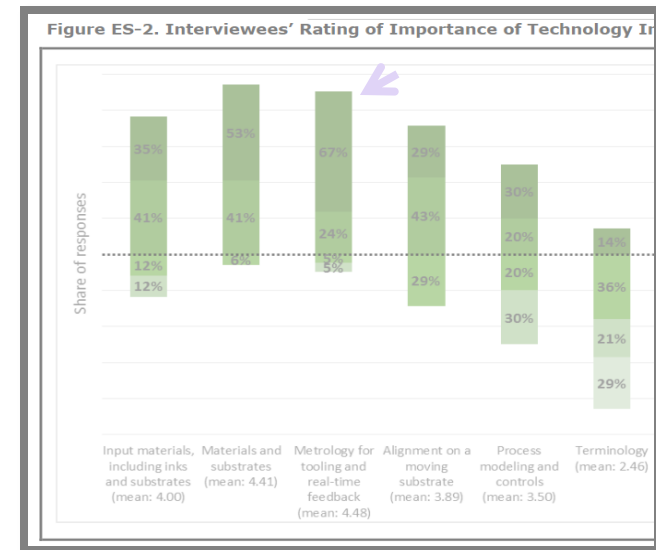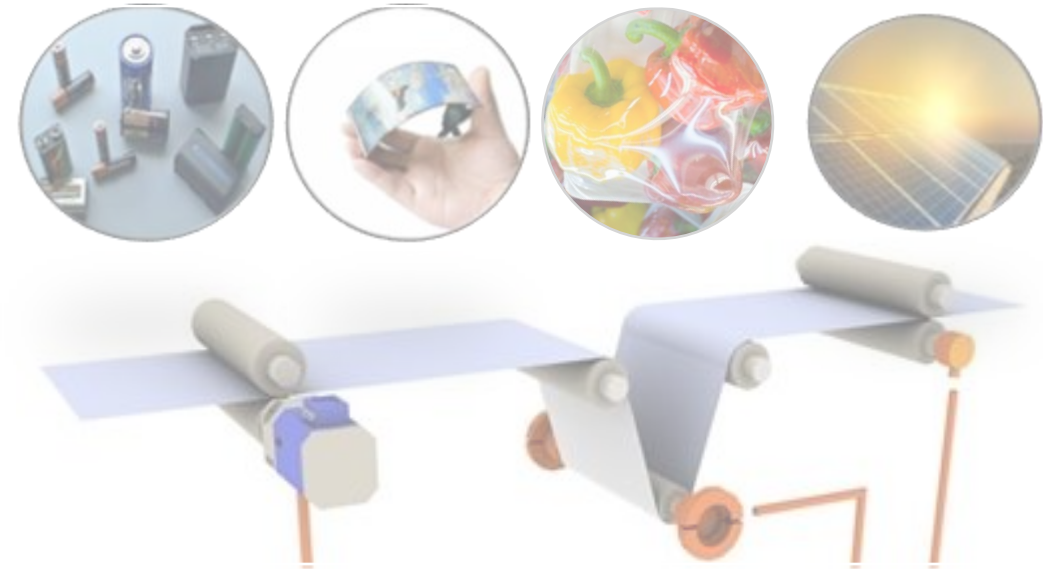
IMPORTANCE OF METROLOGY IN R2R MANUFACTURING

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STATE OF THE ART

POINT THIN FILM INSPECTION

AREA MAPPING

ALL USE FULL
REFLECTANCE SPECTRA,

WHICH CAN BE
COMPUTATIONALLY HEAVY

FOR 52NM ALD MOVING AT 1M/S AL_2O_3 (2014)
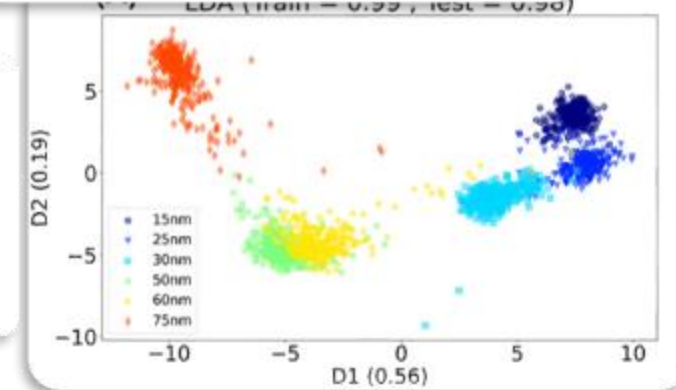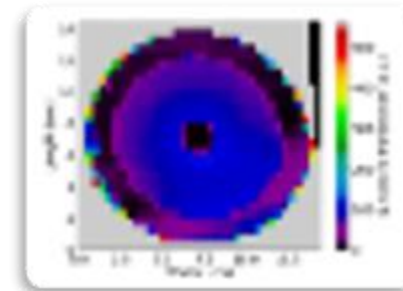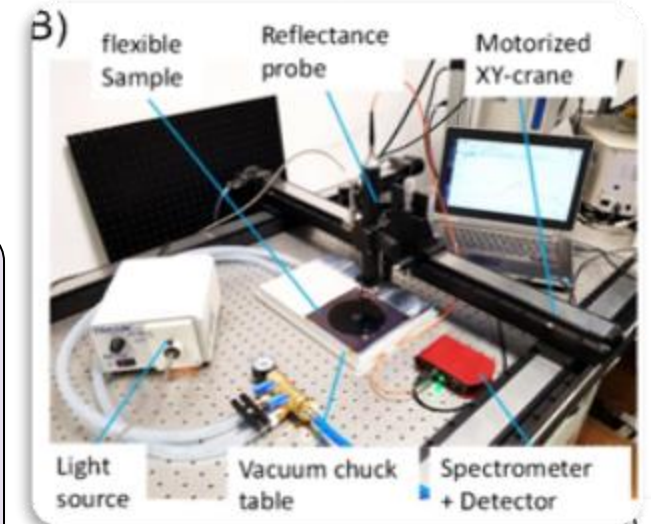
25NM ALxO FILM ON SILICON, (ENRIC, 2021)

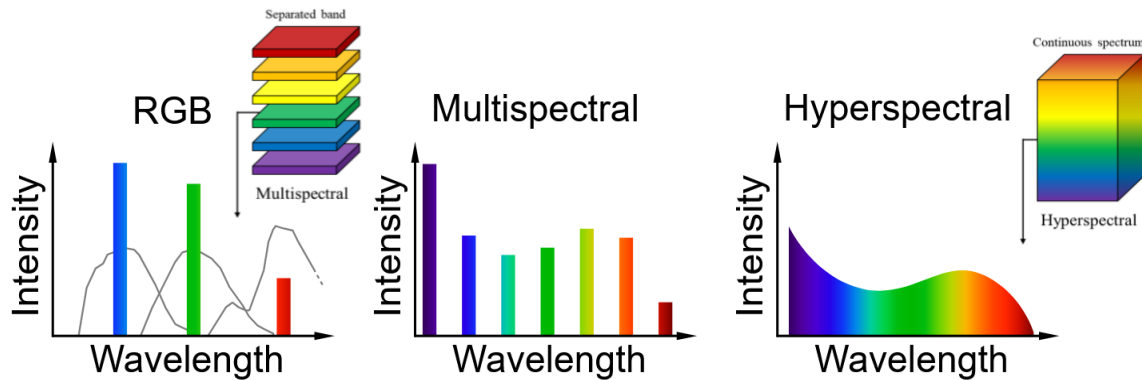A LOW-COST, RECONFIGURABLE THIN-FILM INSPECTION SYSTEM

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BACKGROUND

Reflectance spectra can be used to estimate film uniformity.

- Multispectral and RGB Cameras have **less spectral resolution**

- Each pixel creates has

REDUCED SPECTRAL RESOLUTION WITH HYPERSPECTRAL

APPROACH

- Use multispectral/RGB cameras instead
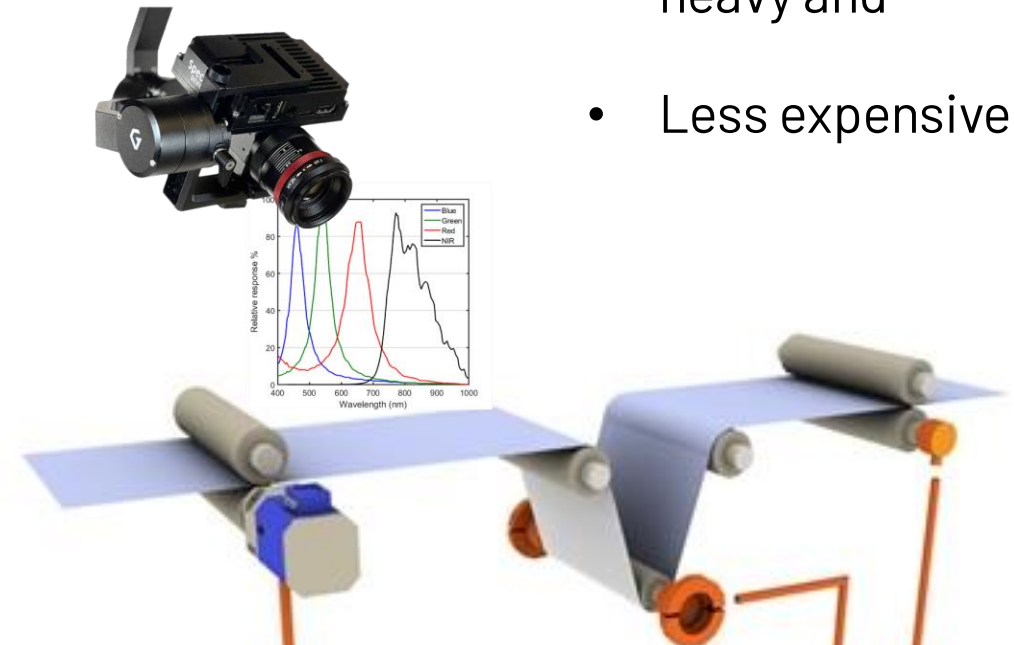
  - Less computationally heavy and
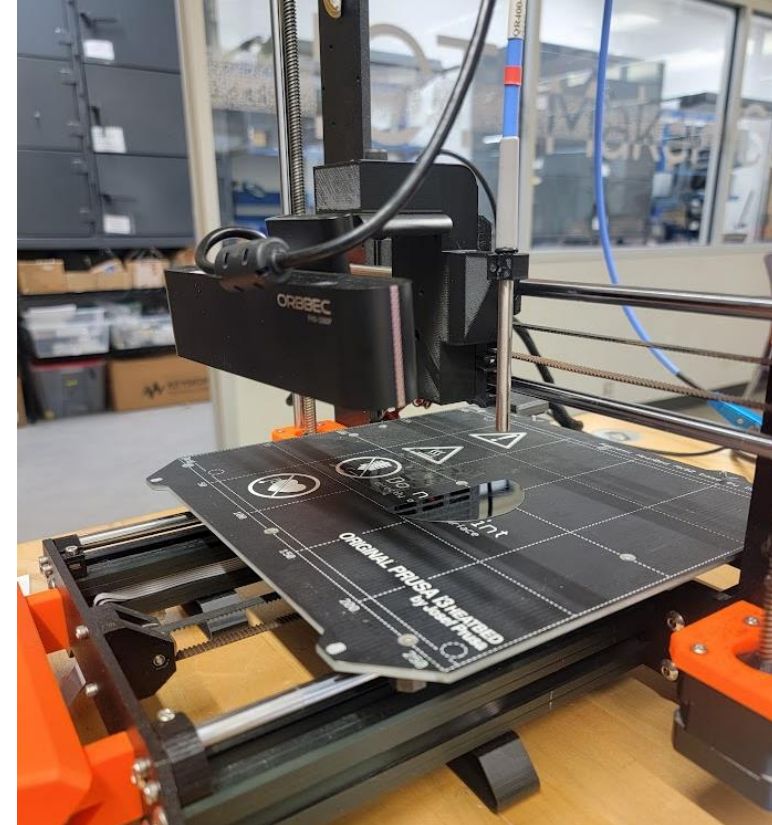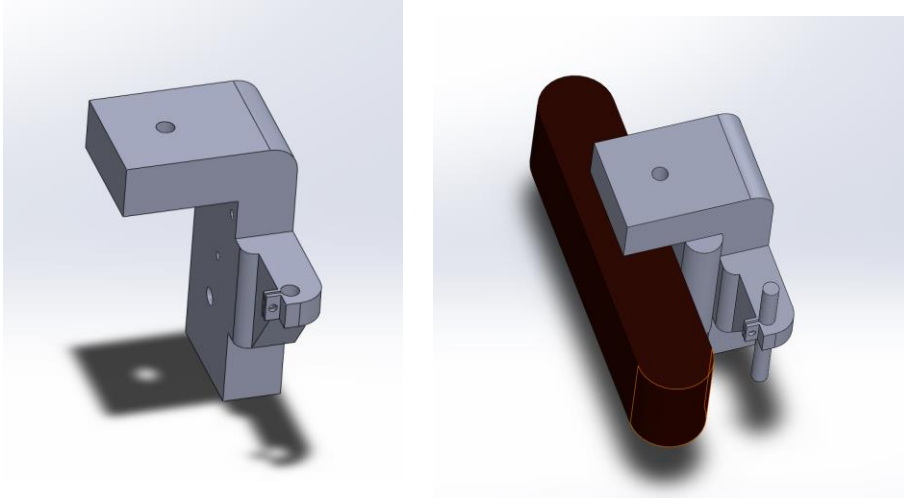
  - Less expensive

ILLUSTRATION OF INDUSTRIAL THIN-FILM INSPECTION

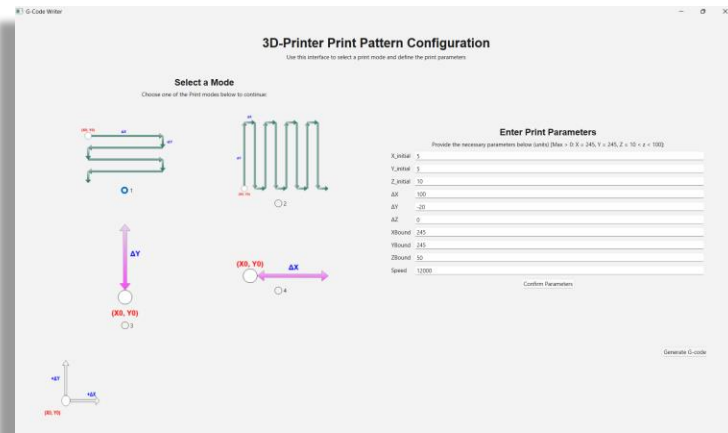UNIVERSITY OF
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WORK SO FAR – GANTRY DESIGN

- Prusa 3D MK3s was adapted to create an operational gantry

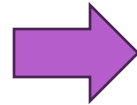- A rig was designed and built to attach camera and spectrometer to the gantry

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WORK SO FAR – USER INTERFACE

- A user interface was built to turn user instruction into machine procedure

G-CODE

PRONTERFACE

PATH

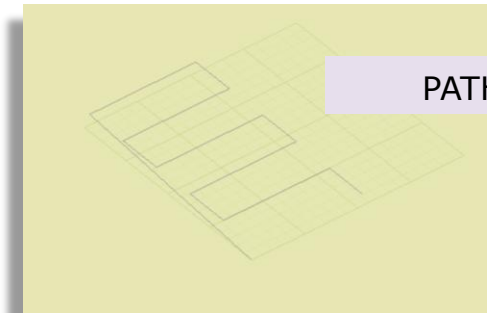USER INTERFACE

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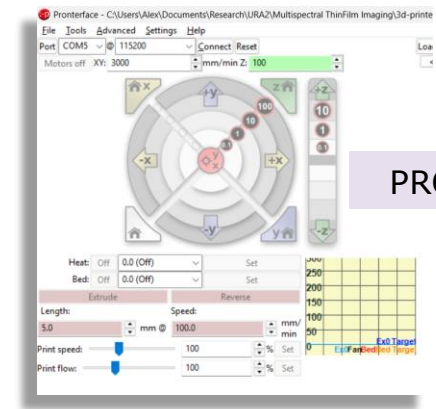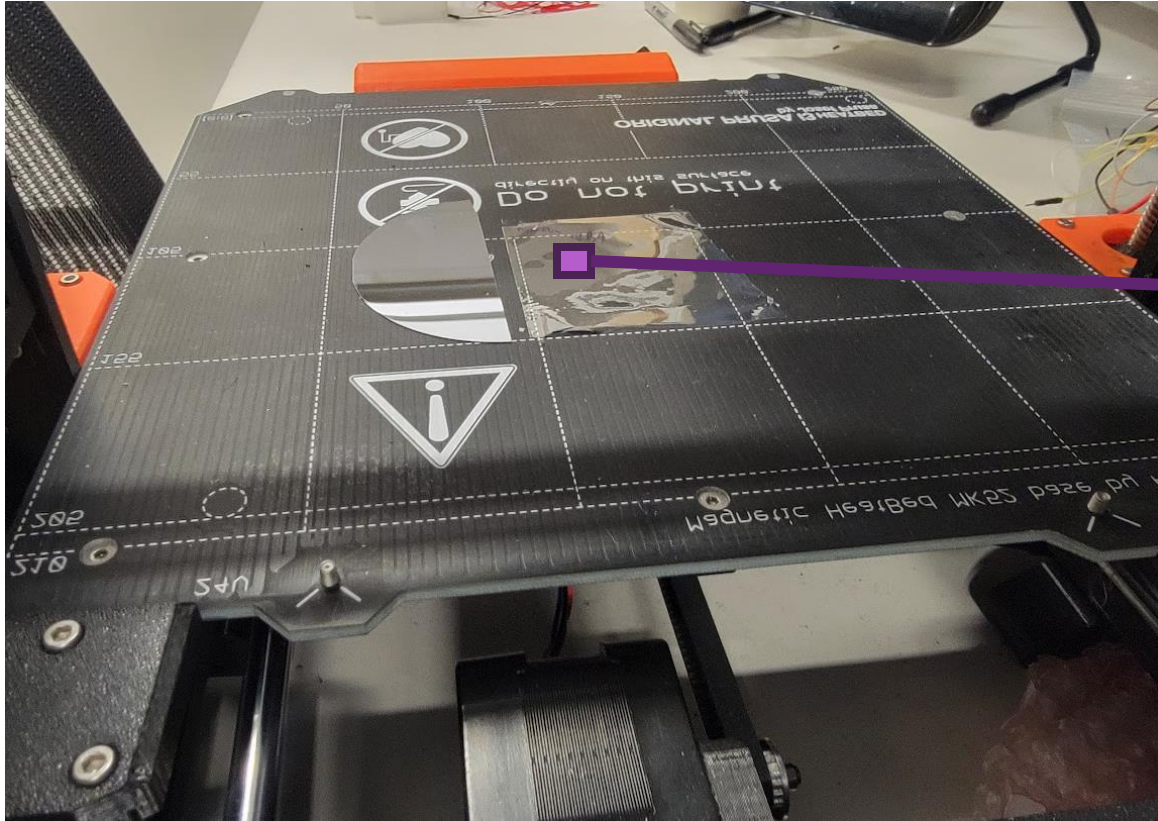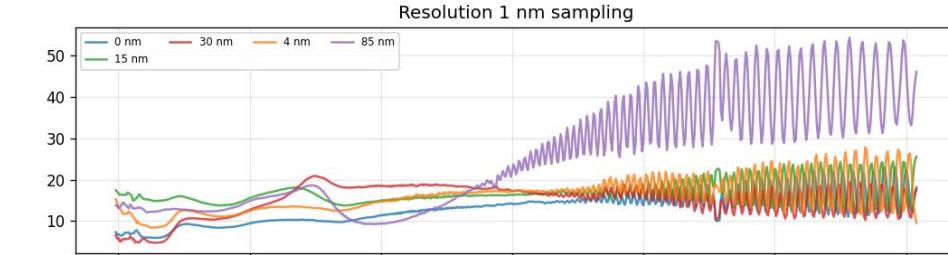
PRELIMINARY DATA

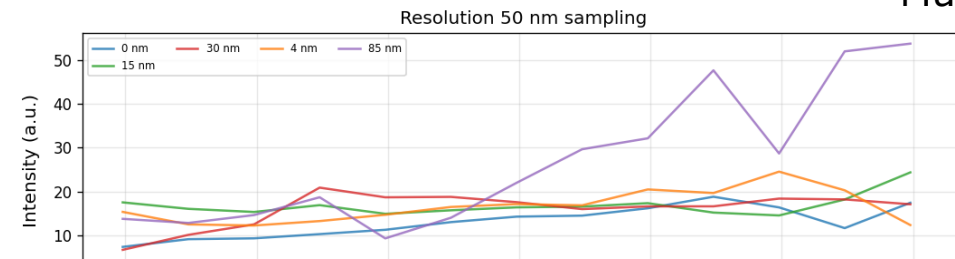
IMAGES OF SAMPLE ON STAGE

Spectrometer

Multispectral

RGB
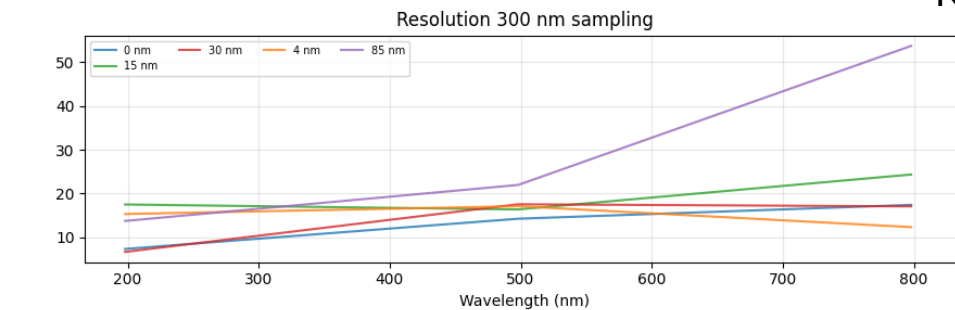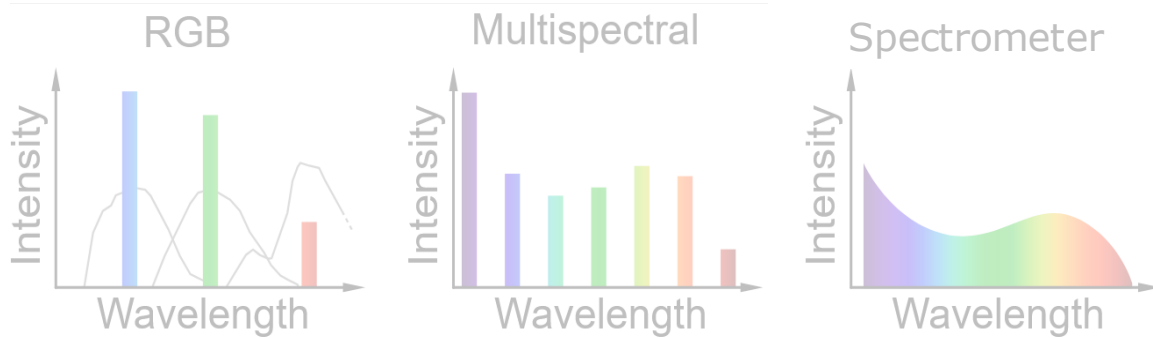

SPECTRAL RESOLUTION REDUCED BY BINNING AND AVERAGING

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FUTURE WORK

- Improve UI and Camera rig

- Test on more samples (from partners)

- Increase metrology accuracy

- Integrate into real system

REDUCED SPECTRAL RESOLUTION WITH HYPERSPECTRAL

THANK YOU!

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Thank you! Questions?