

# Scientific Analysis of Inkjet Prints at the National Gallery of Art

A Survey of Conservation Science  
Analytical Techniques

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**National**  
Gallery  
of Art

# Project Introduction

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Summer 2024 Intern at NGA  
Scientific Research Department

- Mentor: Dr. Joan Walker
- "Characterization of Inkjet Prints"



# What is an Inkjet Print?

10 prints studied from Digital Sample Set  
created by AIC

## Categories of Interest

### 1. Light Sensitivity

- Light fugitivity

### 2. Physical Characteristics

- Printing patterns

### 3. Materials Characterization

- Composition



# Two Types of Analytical Techniques Used

## Non-Destructive

- Non-contact with samples
- Used on artwork

## Destructive

- Sampling, direct contact with sample
- Used on reference materials

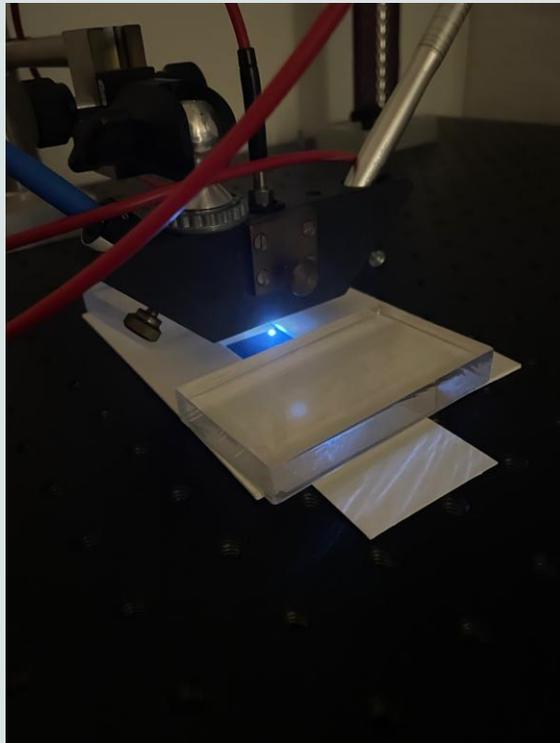


# Light Sensitivity

## Non-Destructive

Microfade Tester  
(MFT)

*Simulated light  
exposure*



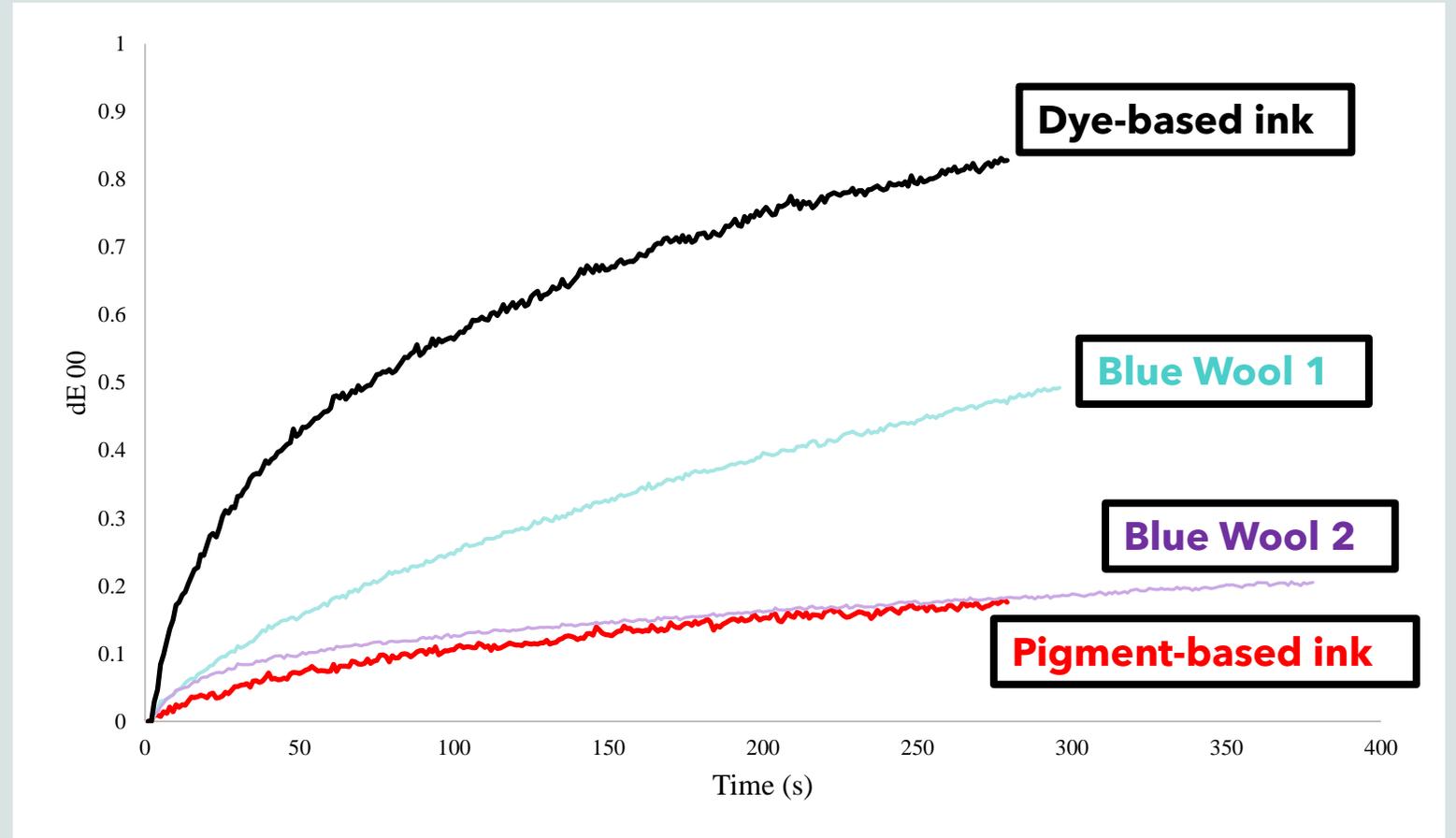
## Destructive

Weatherometer with  
Colorimetry

*Artificial aging with  
light and temperature*



# MFT reveals dye-based inks in study set were light fugitive



Microfade Testing graph reveals two colored inks are above blue wool standard 2.

# Physical Characteristics

## Non-Destructive

Microscopy

*Magnification*



## Destructive

SEM/EDX

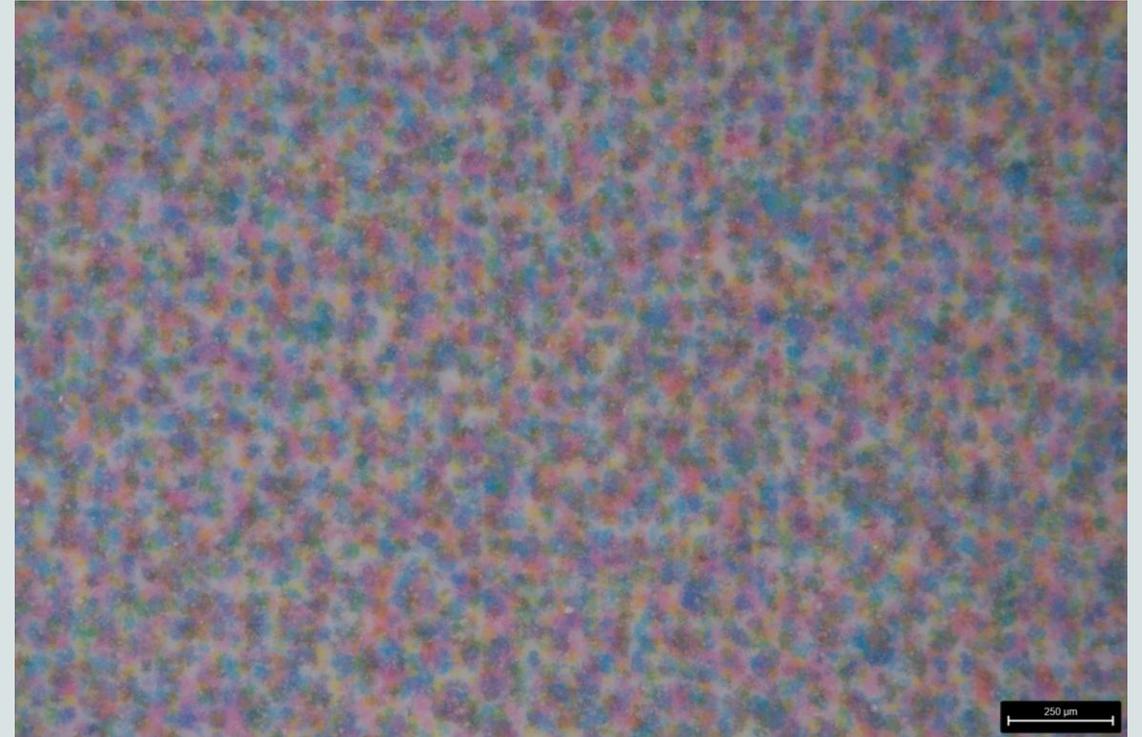
*Sampling; electron beam generates an image*



# Microscopy shows “black” in studied inkjets is made up of multiple colors



Chromogenic print of black dye. Scalebar represents 250  $\mu\text{m}$ .



Inkjet print of black dye. Scalebar represents 250  $\mu\text{m}$ .

# Materials Characterization

## *Elemental Composition*

### **Non-Destructive**

XRF

*Detects specific x-ray signals*



### **Destructive**

SEM/EDX

*Sampling; generates elemental maps*

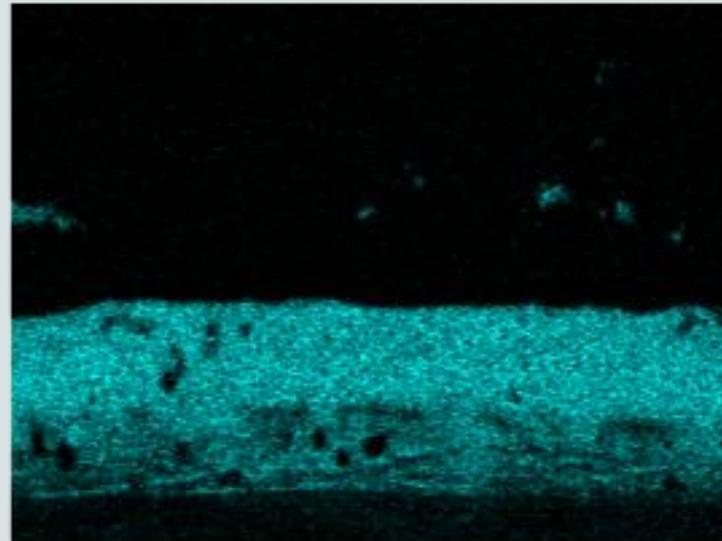


# EDX helped identify RC papers through layer-specific information

**Layers of a resin-coated (RC) paper**



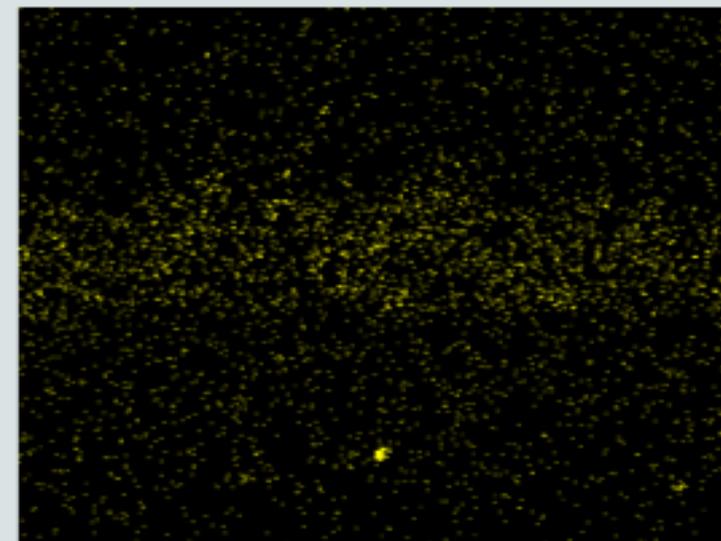
Si K $\alpha$ 1



**Ink Receiving Layer containing silica (SiO<sub>2</sub>)**

50µm

Ti K $\alpha$ 1



50µm

**Middle**

**Polyethylene layer with TiO<sub>2</sub>**

**Surface**

# Materials Characterization

## *Molecular Vibrations*

### **Non-Destructive**

ER-FTIR

*Non-contact method*



### **Destructive**

ATR-FTIR

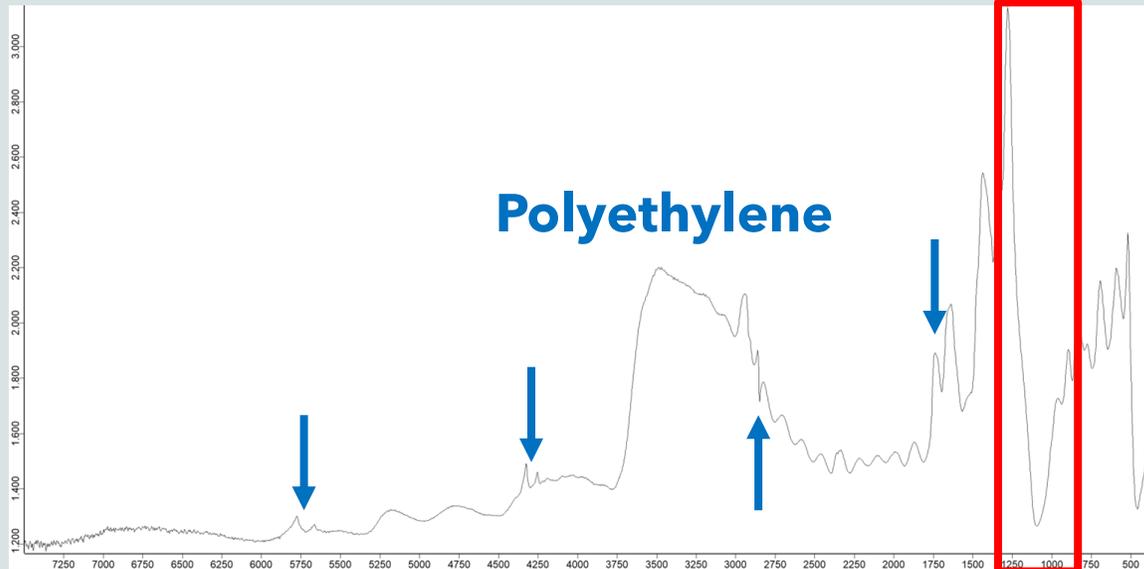
*Contact; surface specific*



# ER and ATR-FTIR used together can reveal functional groups present on the surface

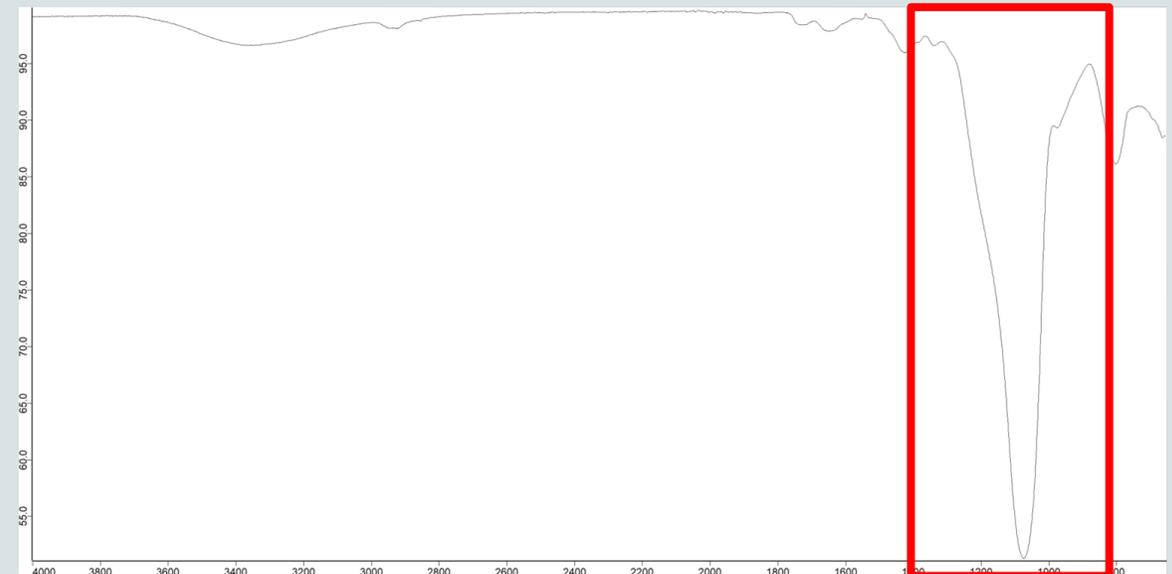
Sample is printed on an RC paper.

ER Spectrum



Polyethylene and silica have been detected in this spectrum.

ATR Spectrum



Silica is present on the surface of the sample.

# Conclusion

## Physical Techniques

### *Light Sensitivity*

- MFT
- Weatherometer with colorimetry

### *Physical Characteristics*

- Microscopy
- SEM/EDX

### *Materials Characterization*

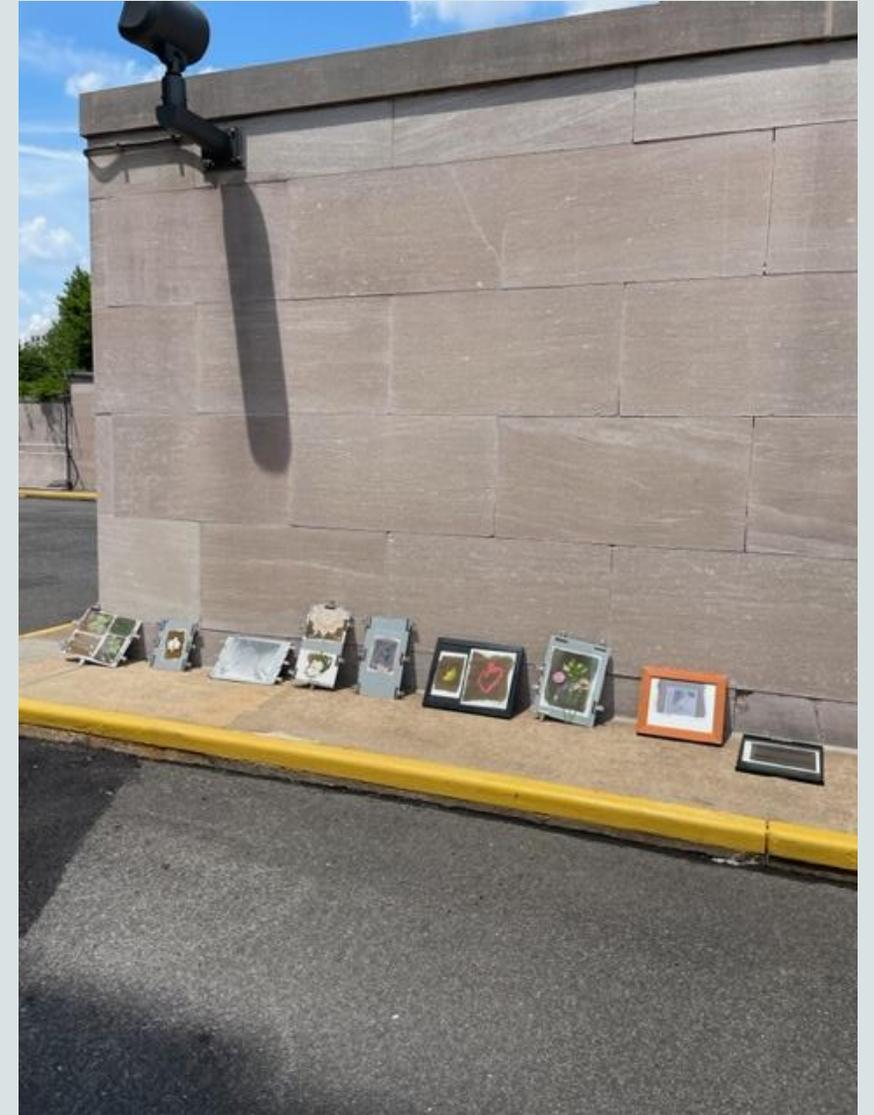
- XRF
- SEM/EDX
- ER-FTIR
- ATR-FTIR



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# Thank you!



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Weatherometer (destructive) light-induced aging reveals degradation of optical brightening agents. Can we tie these results to MFT (non-destructive)?

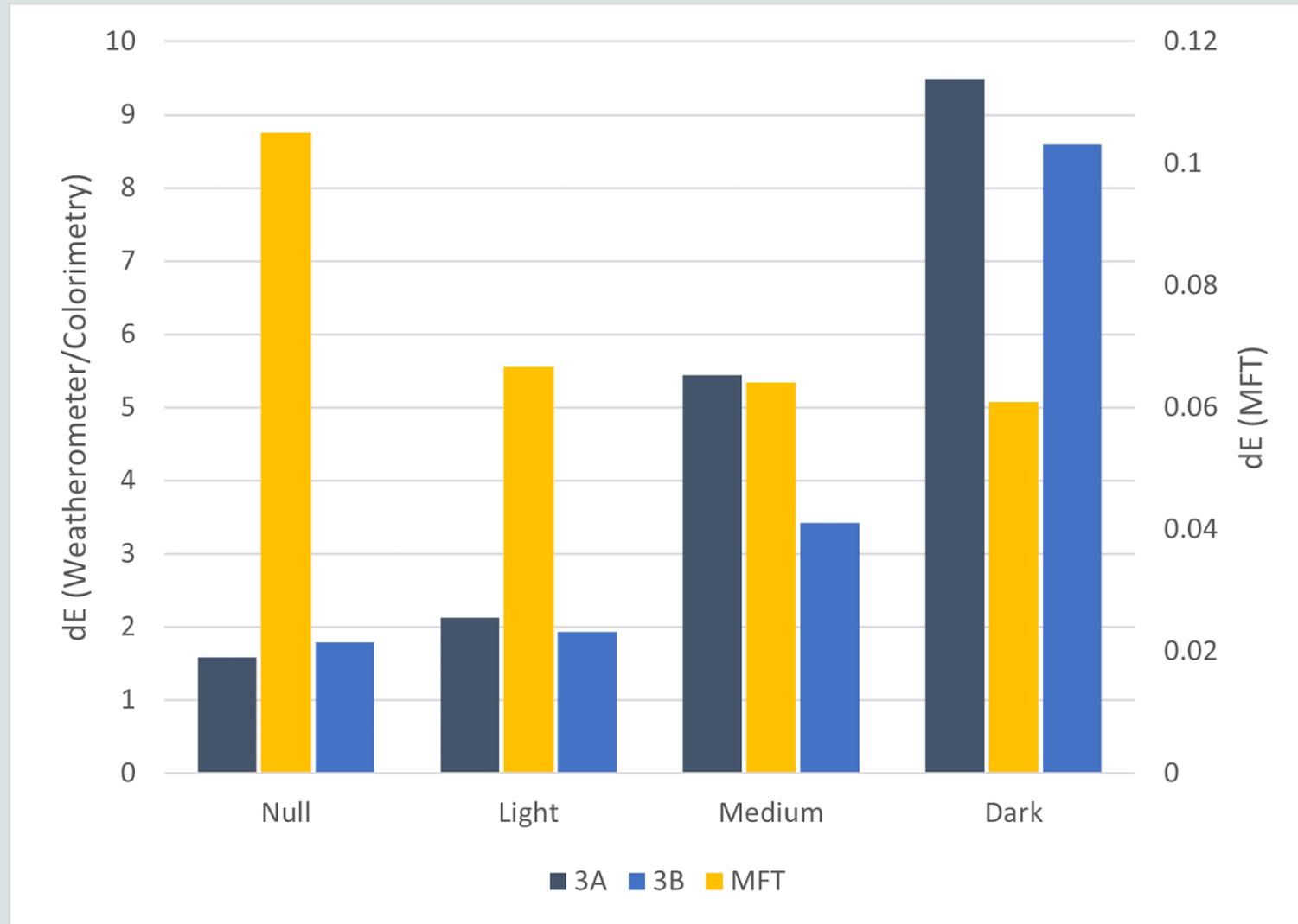
**Unaged**



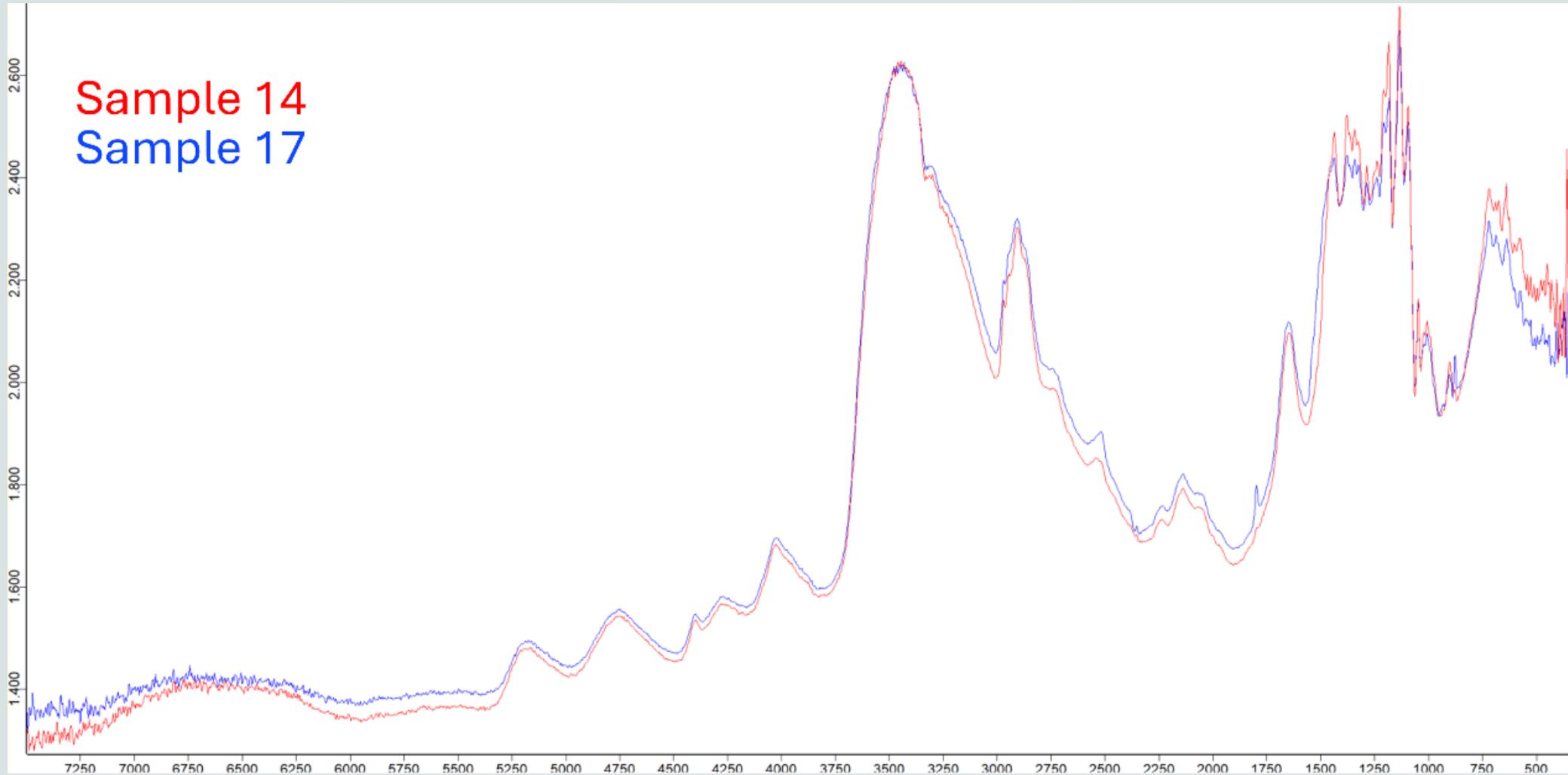
**Aged**



# Weatherometer shows bias in MFT measurements



# Not all coatings are detectable with FTIR analysis



ER-FTIR spectra reveal coatings are undetectable.

# Artificial aging reveals some storage conditions can be destructive

BEFORE AGING



AFTER AGING

