

# SOFI Coating Study

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July 2019

# Background

- A new spray on coating has been demonstrated based on a broadband scatterer. This coating is very early in its development, but has shown promise as a solar reflector due to its high ultraviolet reflectivity. It is referred to as the solar radiation reflecting coating (SRRC) in this presentation.
- In this presentation the coating is applied to spray-on-foam insulation (SOFI). The reflectivity of bare foam and a piece of foam with white paint are compared to the reflectivity of the foam after being sprayed one, two, and three times with the SRRC coating.

# Study Outline

- Two different coating studies were performed
  - Study 1 involved coating the top, “bumpy” surface of the SOFI
  - Study 2 involved coating the bottom, flat surface of the SOFI
- Samples were coated with KSC Solar Radiation Reflecting Coating (Formulation #9)
- Reflectance spectra were collected using a Jasco V-670 UV/Vis/NIR Spectrometer equipped with the ISN-723 Integrating Sphere attachment. The ISN-723 is a 60 mm barium sulfate coated integrating sphere with a 200 nm – 2500 nm spectral range. A white reflective tile (Spectralon) was used as a baseline material. Data was collected from 200 nm – 2400 nm.

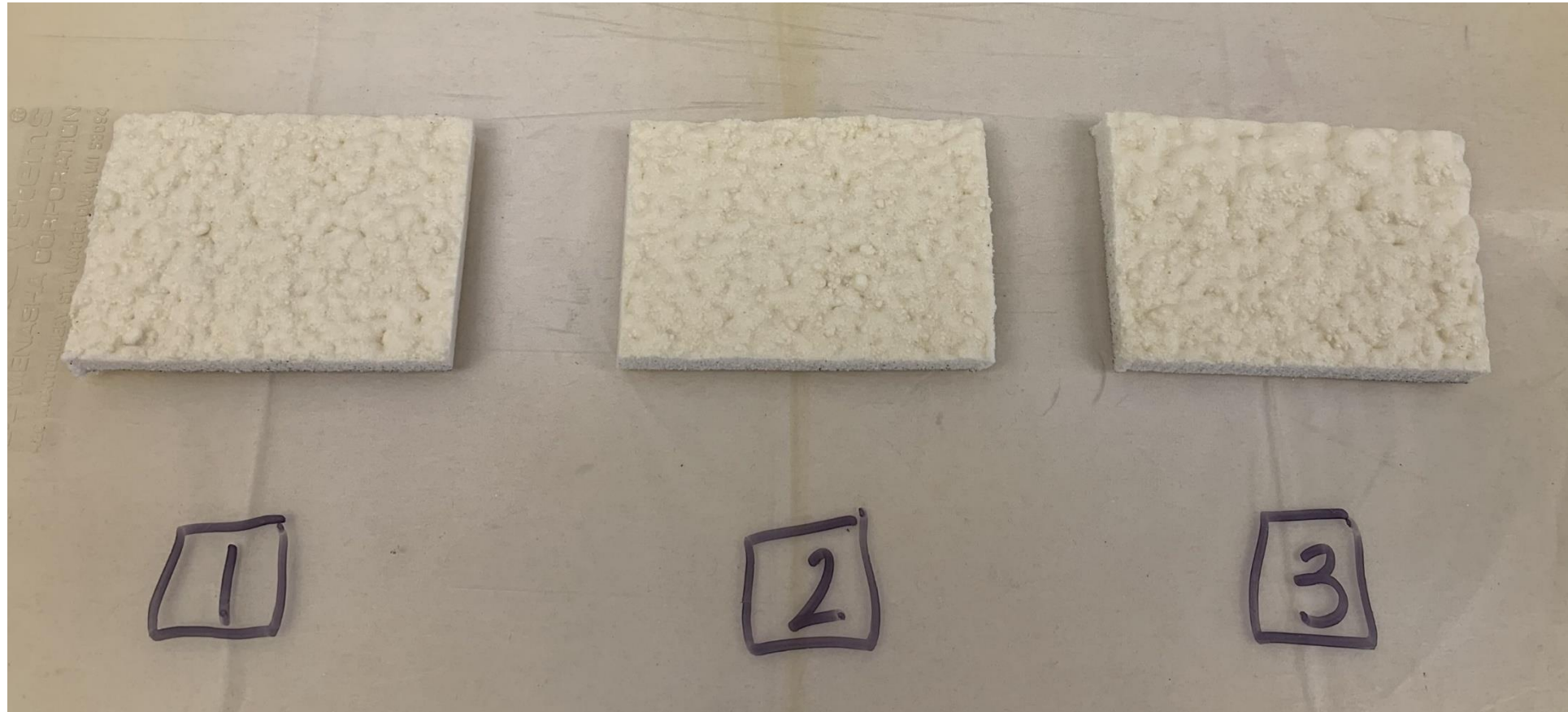
# STUDY 1

## Top-Side Coating

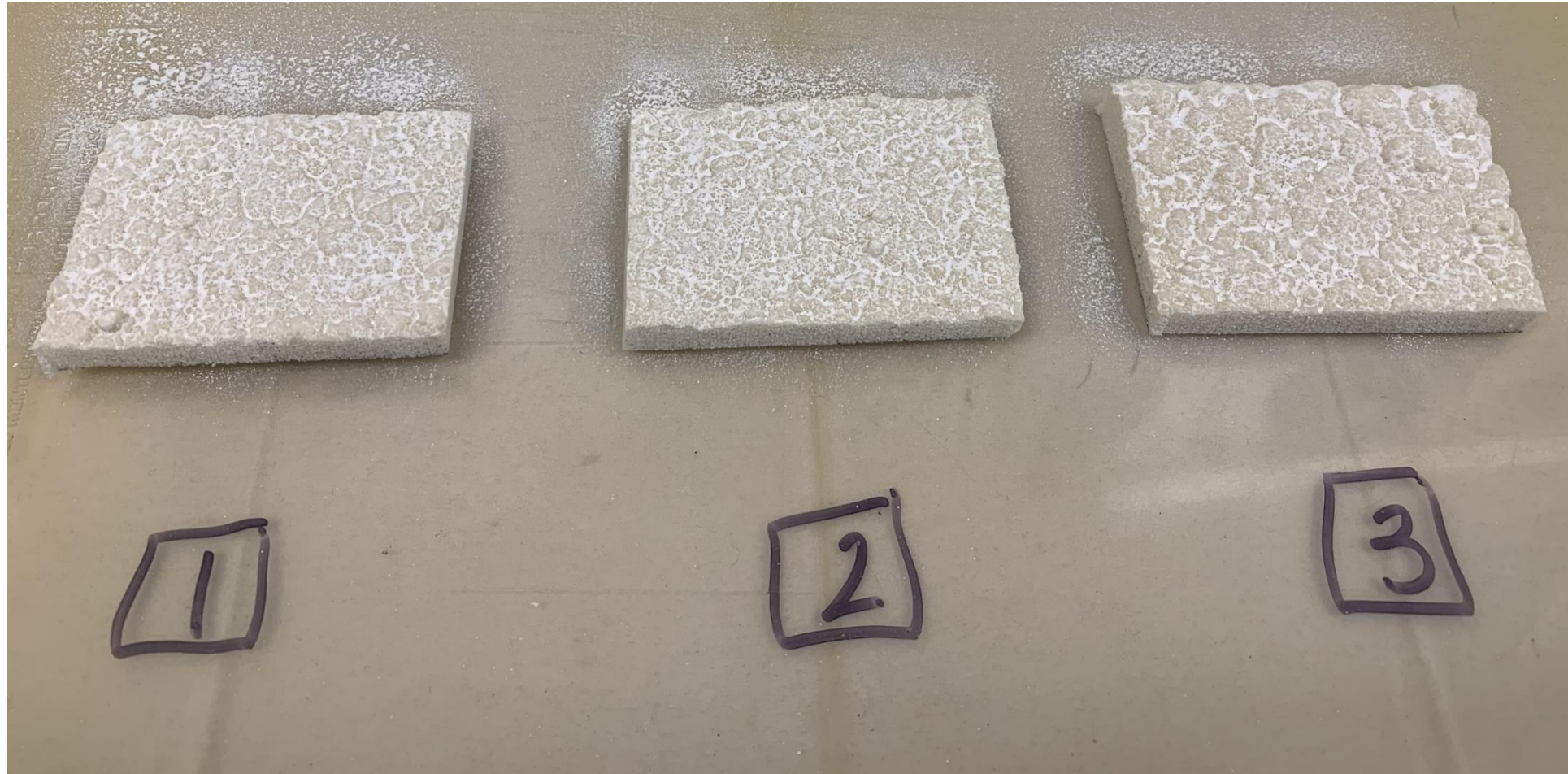
# Sample Preparation

- SOFI samples were cut into sections approximately 2" X 3" in size.
- 3 sections were randomly chosen for coating with the Solar Radiation Reflecting Coating (SRRC)
  - SOFI-1
  - SOFI-2
  - SOFI-3
- A SOFI sample coated with white paint was cut into a section approximately 2" X 2" in size.

# Pre-Coating

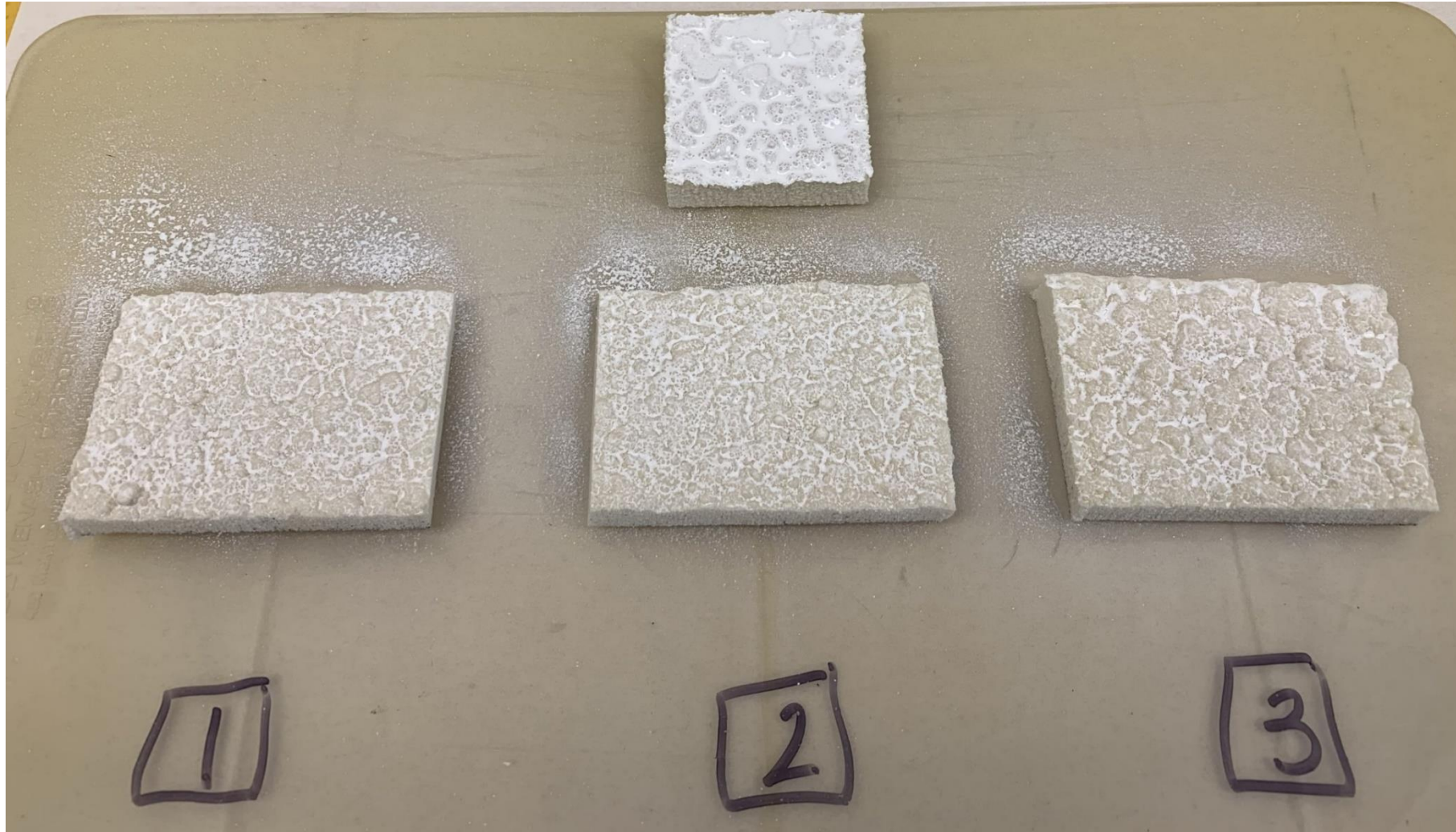


# 1 Layer SRRC





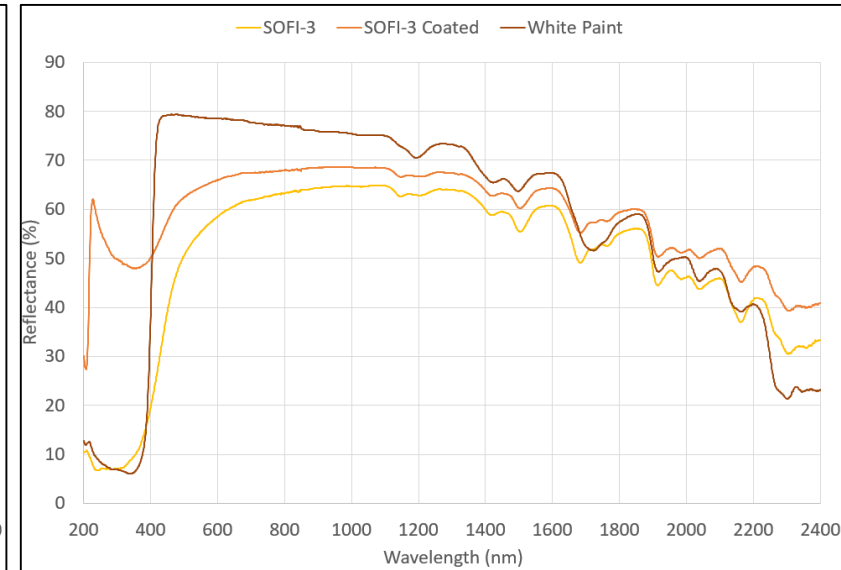
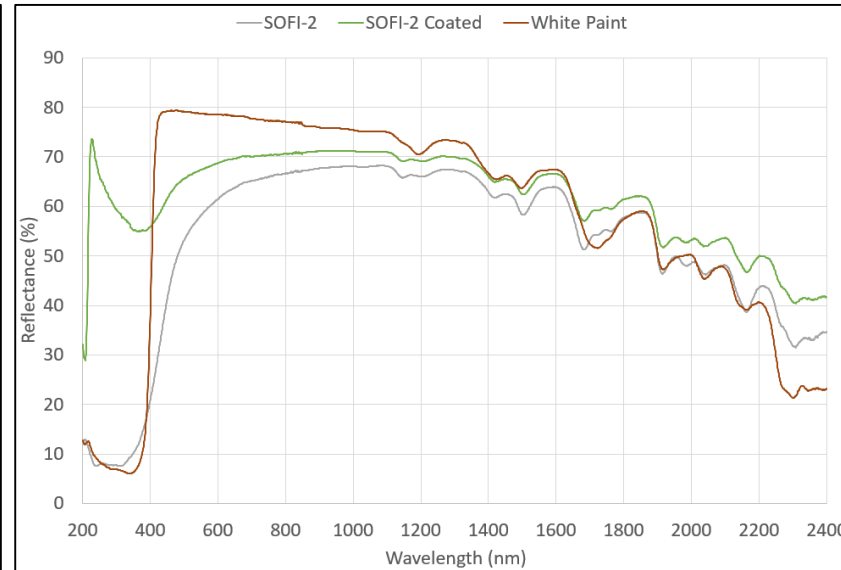
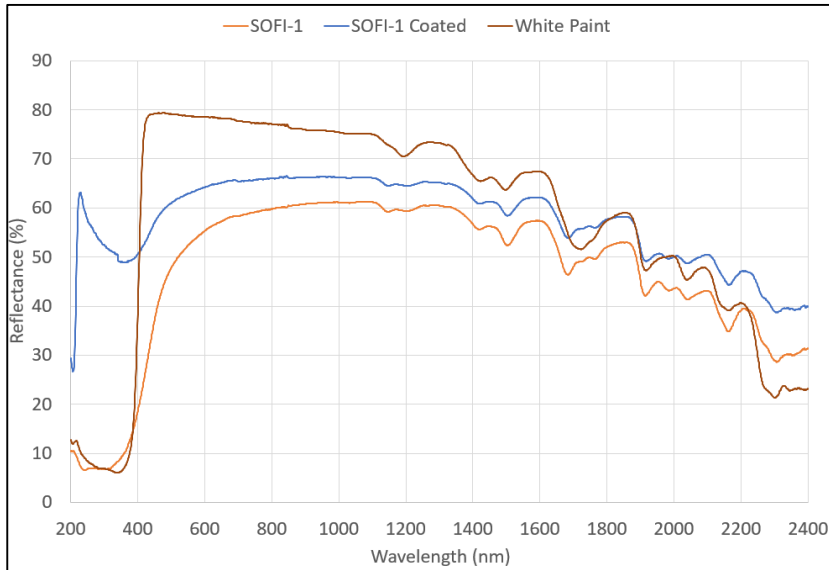
# 1 Layer SRRC and the White Paint Coated Sample



Both the SRRC and the white paint have pooled in the surface recesses. These pooled regions are whiter and made comparison measurements difficult because the surface reflectivity varies.



# 1 Layer SRRC and White Paint Reflectance Spectroscopy

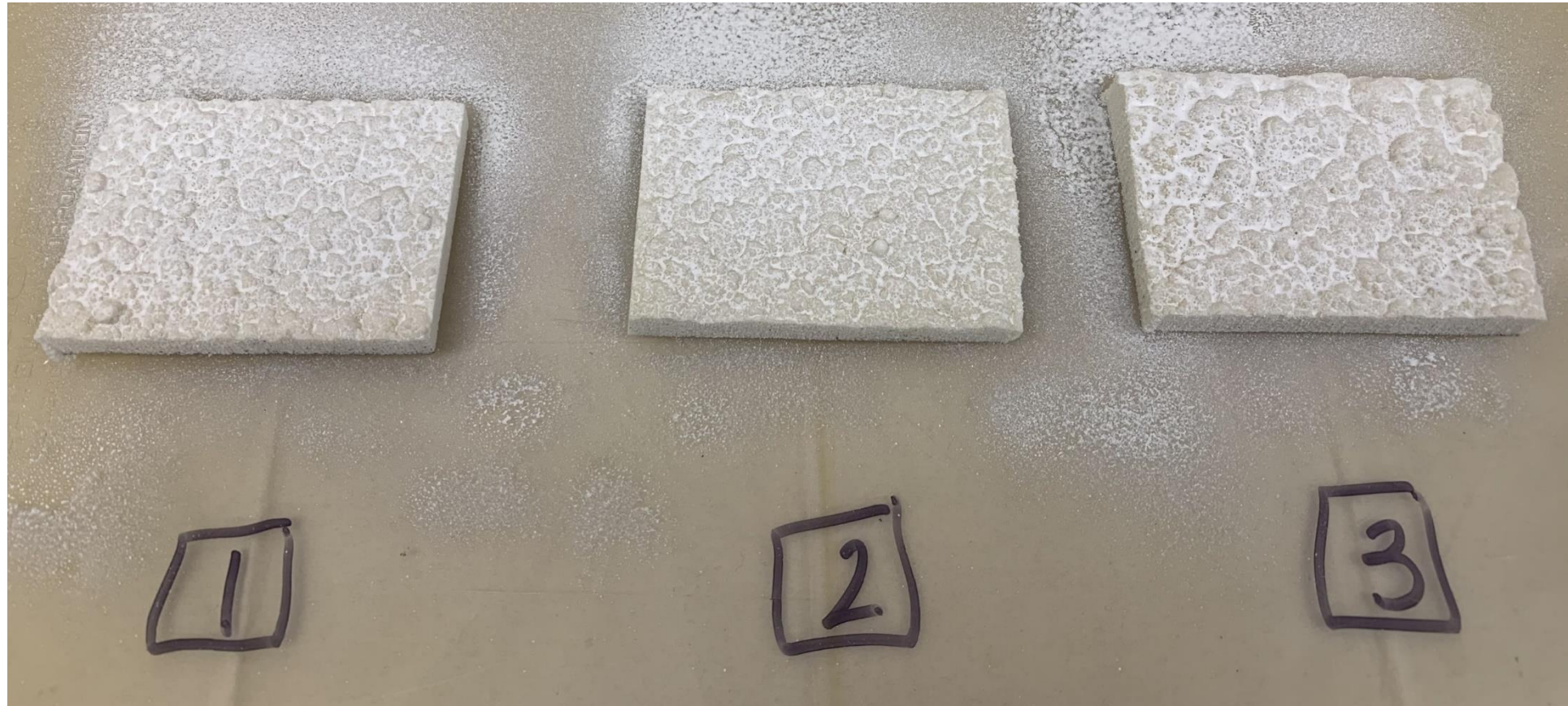


Initial Weight	1.6156g
Final Weight	1.8593g
Coating Weight (1X)	0.2437g
Surface Area	0.0042m <sup>2</sup>
Weight/SA	0.058kgm <sup>-2</sup>

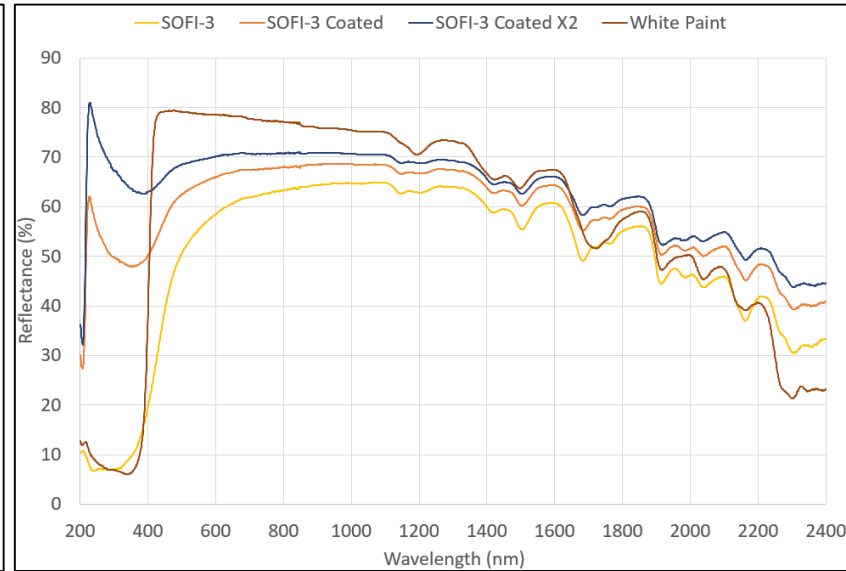
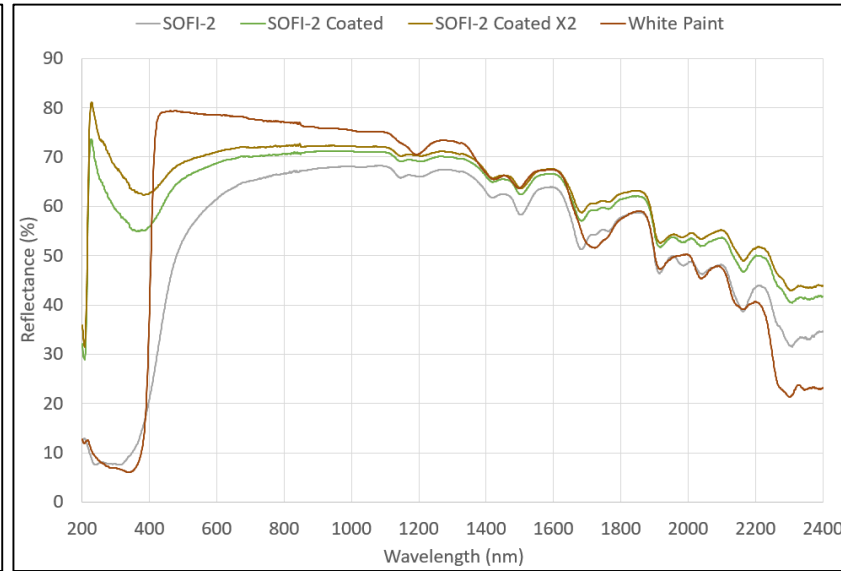
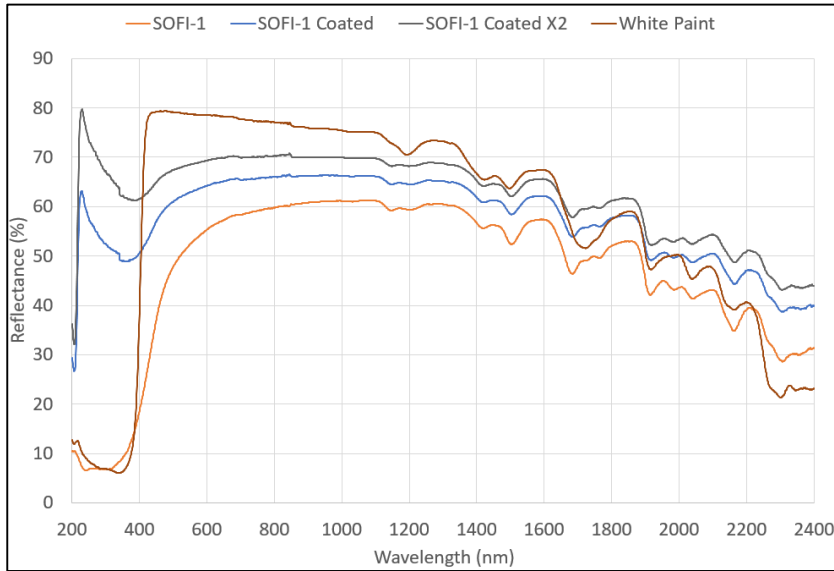
Initial Weight	1.6986g
Final Weight	1.9527g
Coating Weight (1X)	0.2541g
Surface Area	0.0043m <sup>2</sup>
Weight/SA	0.059kgm <sup>-2</sup>

Initial Weight	1.9461g
Final Weight	2.1596g
Coating Weight (1X)	0.2135g
Surface Area	0.0042m <sup>2</sup>
Weight/SA	0.051kgm <sup>-2</sup>

# 2 Layers SRRC



# 2 Layers SRRC and White Paint Reflectance Spectroscopy



Initial Weight	1.6156g
Final Weight	1.9894g
Coating Weight (2X)	0.3738g
Surface Area	0.0042m <sup>2</sup>
Weight/SA	0.089kgm <sup>-2</sup>

Initial Weight	1.6986g
Final Weight	2.0740g
Coating Weight (2X)	0.3754g
Surface Area	0.0043m <sup>2</sup>
Weight/SA	0.087kgm <sup>-2</sup>

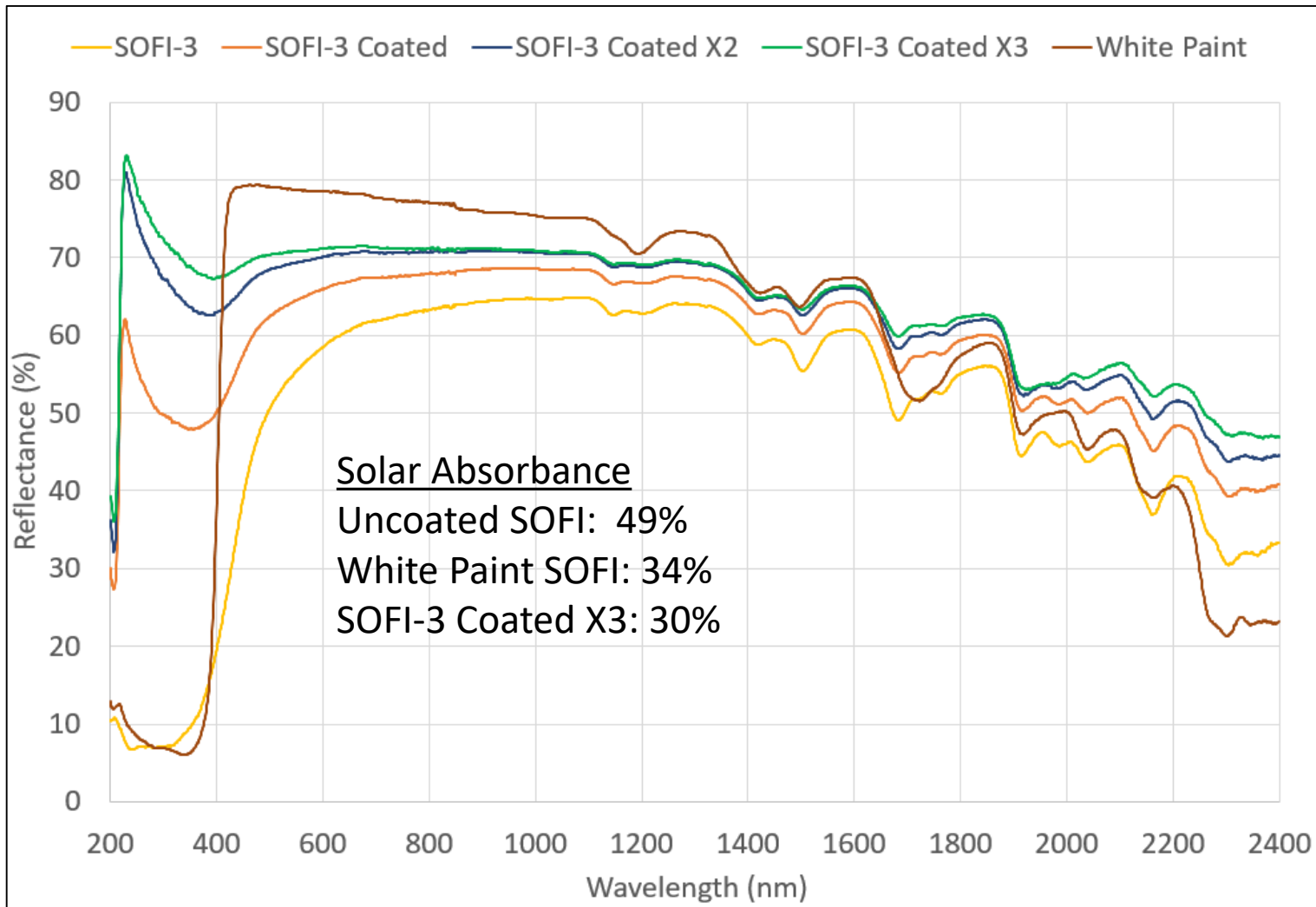
Initial Weight	1.9461g
Final Weight	2.3586g
Coating Weight (2X)	0.4125g
Surface Area	0.0042m <sup>2</sup>
Weight/SA	0.098kgm <sup>-2</sup>

# 3 Layers SRRC





# 3 Layers SRRC and White Paint Reflectance Spectroscopy



Initial Weight	1.9461g
Final Weight	2.7262g
Coating Weight (3X)	0.7801g
Surface Area	0.0042m <sup>2</sup>
Weight/SA	0.19kgm <sup>-2</sup>

# Discussion

Spraying on the uneven top side of the SOFI samples yields a non-uniform coating which is difficult to characterize, so all of the data shown above is subject to positional (i.e. placement of the sample in the reflectometer) error.

Also, additional layers improve the performance, but not as much as expected, possibly due to the coating running off of the peaks and into the recesses. In other words, the absorption of the uncoated SOFI peaks are limiting the performance of the SRRC.

The solar absorbance numbers were calculated using a 5778 K blackbody model of the Sun. This is reasonable, but under-estimates the Sun's UV emission. However, the Spectralon standard has UV absorbance and results in an overestimate of the effectiveness of coatings in the ultraviolet. Of these two effects, the Spectralon is likely dominant, so the UV effectiveness of the new SRRC coating is overestimated by the spectra shown above.



# Concerns: SOFI-3



Potential Issue with Coating Flaking Off When Too Thick

The SRRC adheres to the SOFI but can be rubbed off. In depressions where it is thick it can flake off. More work is needed to improve the coatings strength, but some improvement can be made by applying it to a more even surface.

# STUDY 2

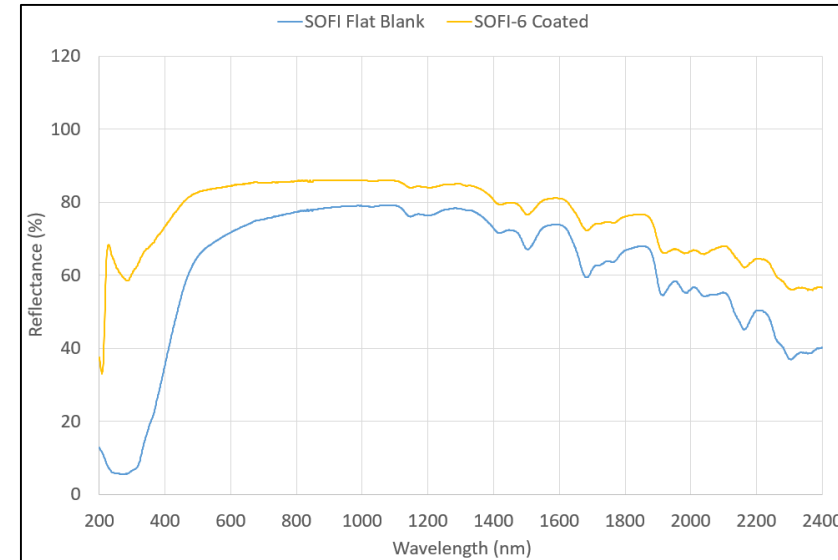
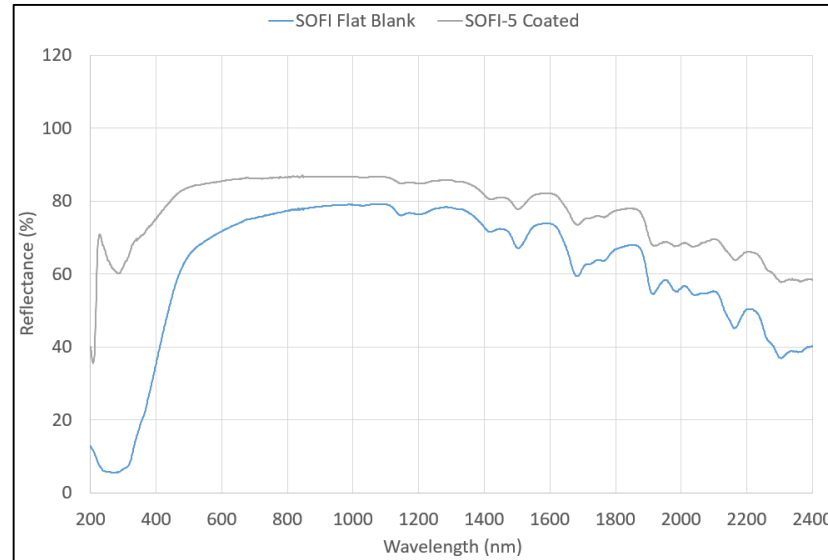
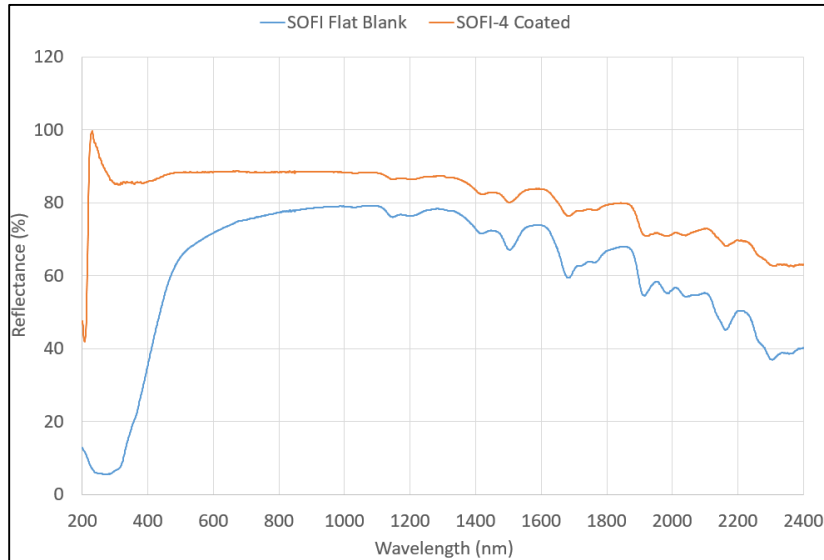
## Bottom-Side Coating

A more uniform surface

# Sample Preparation

- SOFI samples were cut into sections approximately 2" X 3"
- 3 sections randomly chosen for coating with Solar Radiation Reflecting Coating (SRRC)
  - SOFI-4
  - SOFI-5
  - SOFI-6

# 1 Layer SRRC Reflectance Spectroscopy



Initial Weight	2.1697g
Final Weight	2.6011g
Coating Weight (1X)	0.4314g
Surface Area	0.0046m <sup>2</sup>
Weight/SA	0.094kgm <sup>-2</sup>

Initial Weight	1.7438g
Final Weight	2.1887g
Coating Weight (1X)	0.4449g
Surface Area	0.0043m <sup>2</sup>
Weight/SA	0.10kgm <sup>-2</sup>

Initial Weight	1.6329g
Final Weight	2.0716g
Coating Weight (1X)	0.4387g
Surface Area	0.0042m <sup>2</sup>
Weight/SA	0.10kgm <sup>-2</sup>

# 2 Layers SRRC



SOFI-4 Coated X2

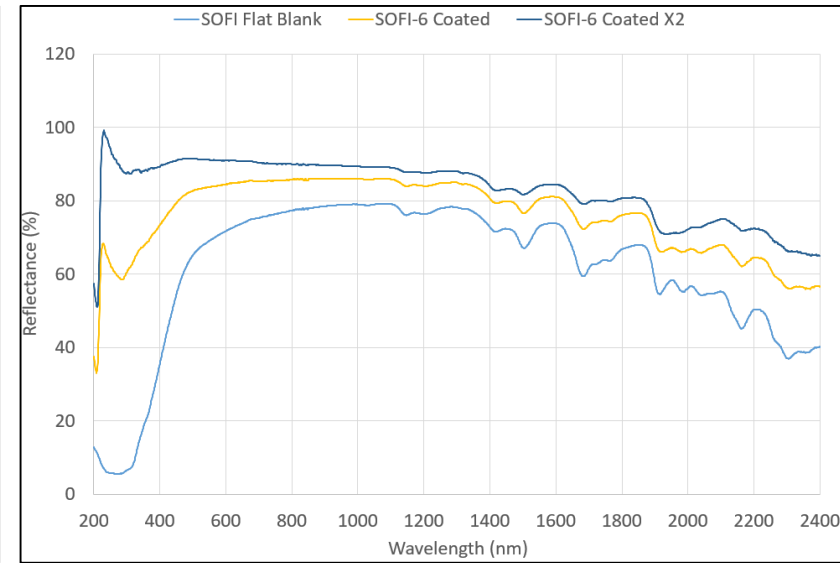
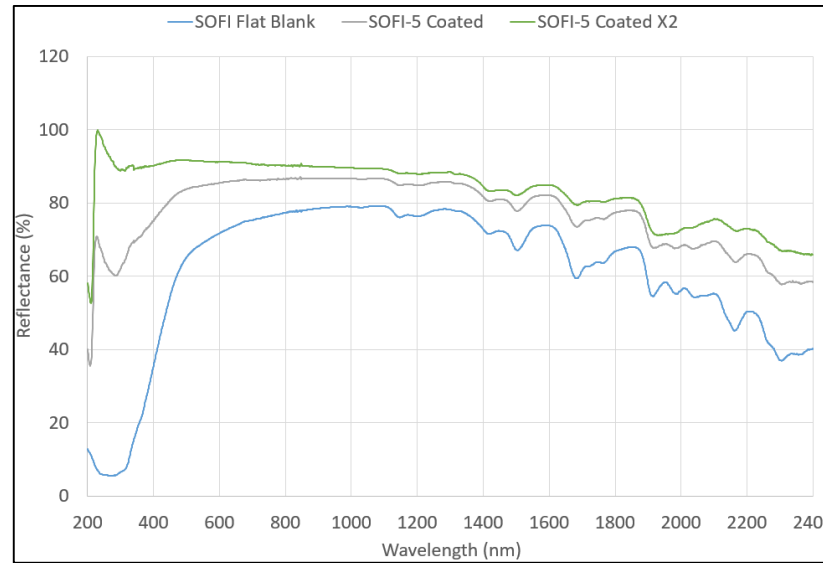
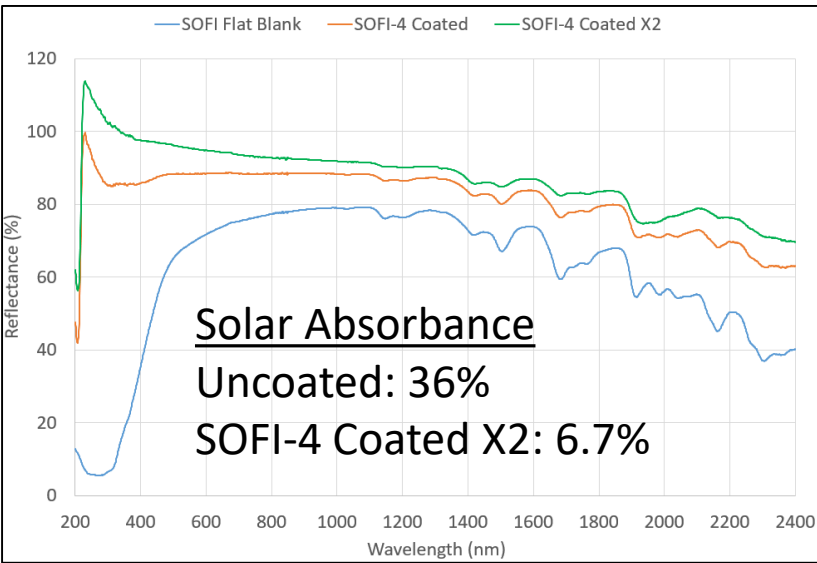


SOFI-5 Coated X2



SOFI-6 Coated X2

# 2 Layers SRRC Reflectance Spectroscopy



Initial Weight	2.1697g
Final Weight	3.0609g
Coating Weight (2X)	0.8912g
Surface Area	0.0046m <sup>2</sup>
Weight/SA	0.194kgm <sup>-2</sup>

Initial Weight	1.7438g
Final Weight	2.7370g
Coating Weight (2X)	0.9932g
Surface Area	0.0043m <sup>2</sup>
Weight/SA	0.231kgm <sup>-2</sup>

Initial Weight	1.6329g
Final Weight	2.5750g
Coating Weight (2X)	0.9421g
Surface Area	0.0042m <sup>2</sup>
Weight/SA	0.153kgm <sup>-2</sup>



# Conclusions

- SRRC coated samples showed improved reflectance in the UV region compared to uncoated and white paint coated SOFI samples.
- Reflectance improved with each additional application of SRRC but there was sample to sample variation.
- Neither white paint nor the SRRC could be applied evenly over a non-uniform surface.
- A moderately thick uniform layer of SRRC can achieve impressive solar reflectivity results.