Effects of Ultraviolet-C Irradiation on Aircraft Cabin Interiors

Advanced **V**irtual **E**ngineering and **T**esting Laboratories

Aswini Kona Ravi
National Institute for Aviation Research
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Agenda

Effects of Ultraviolet-C Irradiation on Aircraft Cabin Interiors

- Research Team
- Project Motivation, Overview & Approach
- Ultraviolet-C Wavelength Matrix
- Mechanical Test Setup & Evaluated Properties
- Test Results & Discussion
- Summary & Conclusions

Research Team

Effects of Ultraviolet-C Irradiation on Aircraft Cabin Interiors

- NIAR AVET:
  - **PI:** Gerardo Olivares Ph.D.
  - **Researchers:** Aswini Kona Ravi, Akhil Bhasin, Luis Gomez, Luis Daniel Castillo.
  - **Student Researchers:** Tanat Maichan, Clayton Ehrstein, Carlos Gatti.
- **FAA Technical Monitor**: Cindy Ashforth.
- **Other FAA Personnel**: Jeff Gardlin, Ahmet Oztekin.
- **Industry Collaboration**:
  - **Aero HygenX:** JP Floyd, Kris Rupay.
  - **Honeywell Aerospace:** Emir Rahislic, Stephen Yates.

Background

Effects of Ultraviolet-C Irradiation on Aircraft Cabin Interiors

- Motivation & Key Issues
  - Covid-19 pandemic outbreak.
  - Increased aircraft disinfection procedures enforced by regulatory bodies.
- Objective & Scope
  - Evaluate and understand the long-term effects of use of disinfectants on aircraft interiors.
  - Project scope extends to liquid and ultraviolet-c disinfection on aircraft cabin and seating materials.
- Approach
  - Identify the commonly used disinfectants for aircraft interior cleaning.
  - Subject the materials to accelerated disinfection experiments.
  - Evaluate the effects on mechanical properties, flammability, weight and color.

Project Overview

Effects of Ultraviolet-C Irradiation on Aircraft Cabin Interiors

PHASE-I: Effects of Liquid Disinfectants on Aircraft Seating Interiors

- 5 Liquid Disinfectants
- 17 Seating Materials
- Properties:
  - Flammability &
  - Mechanical

PHASE-II: Effects of UV-C Disinfection on Aircraft Seating Interiors

- 3 Wavelength Configurations
- 6 Seating Materials
- Properties:
  - Mechanical

PHASE-III: Effects of Liquid and UV-C Disinfection on Aircraft Cabin Interiors

- Cabin Materials: Decorative laminates, floor carpets & honeycomb sandwich panels.

Project Scope

Effects of Ultraviolet-C Irradiation on Aircraft Cabin Interiors

Aircraft Cabin & Seating Interiors

Plastics –

- Kydex 6565
- Boltaron 9815E
- Lexan XHR
- Boltaron 9815N
- Ultem 9075
- Ultem 9085

Honeycomb –

- Nomex core with fiberglass/phenolic resin

Composite –

- Fiberglass (G-10/FR4)

Accelerated UV-C Disinfection

Wavelength Configurations

- 222 nm
- 253.4 nm &
- 280 nm

Ultraviolet-C Wavelength Test Matrix

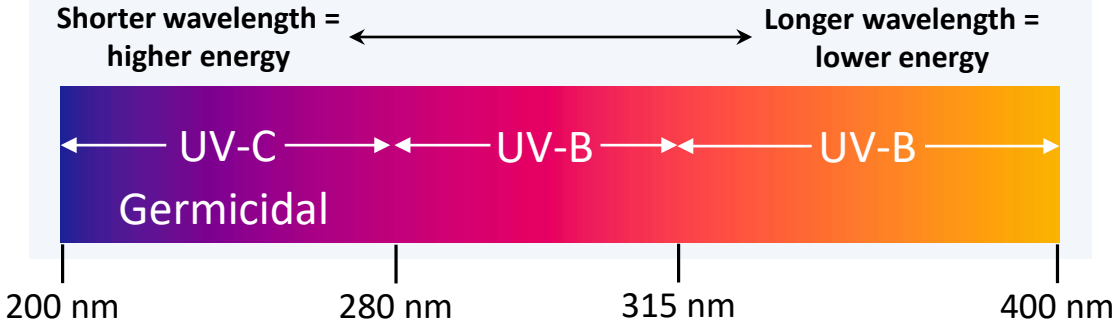
Effects of Ultraviolet-C Irradiation on Aircraft Cabin Interiors

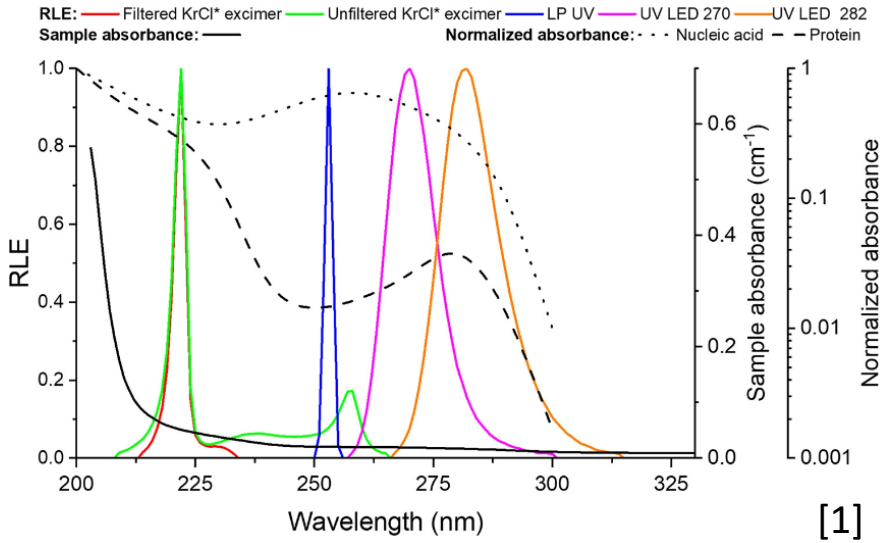
Ultraviolet Irradiation – Overview

Effects of Ultraviolet-C Irradiation on Aircraft Cabin Interiors

Ultraviolet Germicidal Irradiation (UVGI)

- **UVGI: Use of ultraviolet energy to inactivate microbes.**





[1]

Lamp Technologies

Continuous UV-C irradiation –

- Monochromatic lamps – 254 nm, 222 nm
  - Low pressure, medium pressure mercury lamps.
  - Excimer lamps.
- Light Emitting Diodes (LEDs) – 280 nm

UV Critical Parameters

UV Dose = UV Intensity x Exposure Time

- **UV Dose (mJ/cm²):** amount of irradiation absorbed per unit area.
- **UV Intensity (mW/cm²):** power passing through a unit area perpendicular to the direction of propogation.
- **Exposure Time (s):** duration of the UV dose .

[1] Ben, Ma et al, UV Inactivation of SARS-CoV-2 across the UVC Spectrum: KrCl* Excimer, Mercury-Vapor, and Light-Emitting-Diode (LED) Sources, Applied and Environmental Biology, Oct 2021.

Wavelength Configuration: 222 nm

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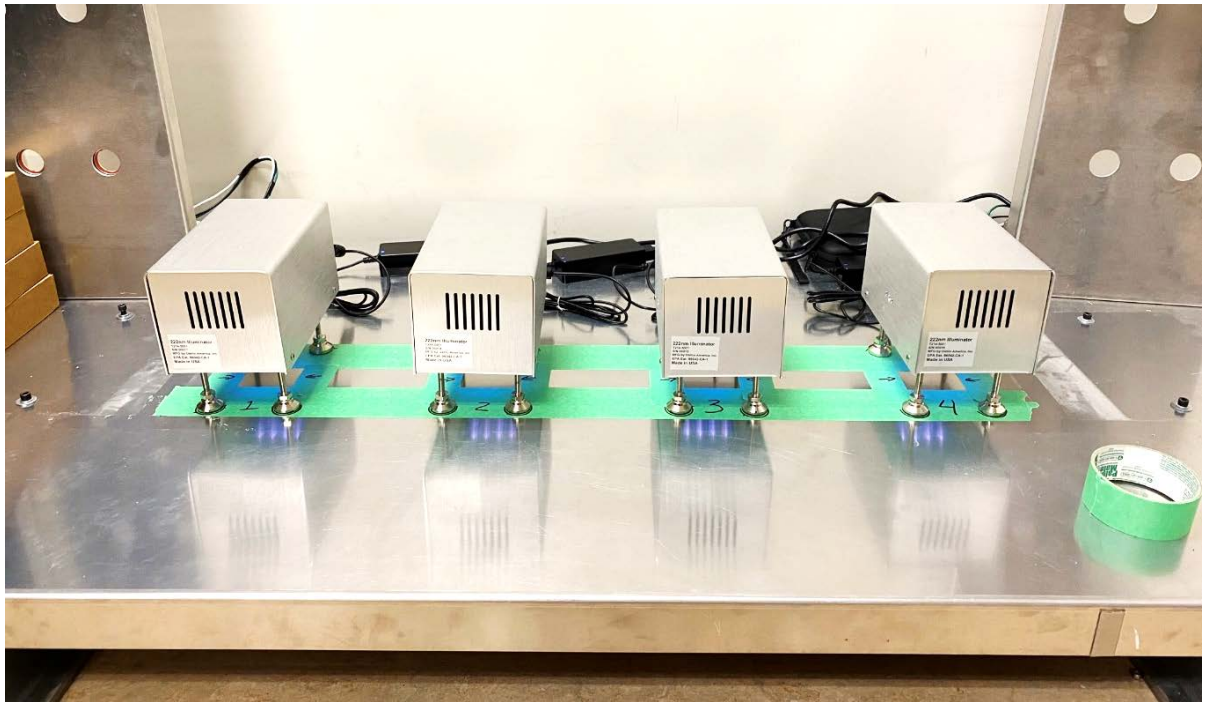
UV-C Source: Ushio Care222 B1 Illuminator



Single Treatment Dose:
3 mJ/cm^2 [2]

Average Intensity (mW/cm^2)	Cumulative Time (Years)	Cumulative Dosage (mJ/cm^2)	Exposure Duration (minutes)
0.78	One	1095	23.5
	Four	4380	94
	Eight	8760	188

[2] Kitagawa, Hiroki et al, Effectiveness of 222-nm ultraviolet light on disinfecting SARS-CoV-2 surface contamination, American Journal of Infection Control, 2020.

Wavelength Configuration: 253.4 nm

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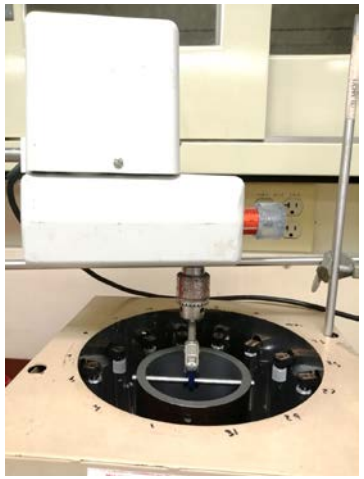
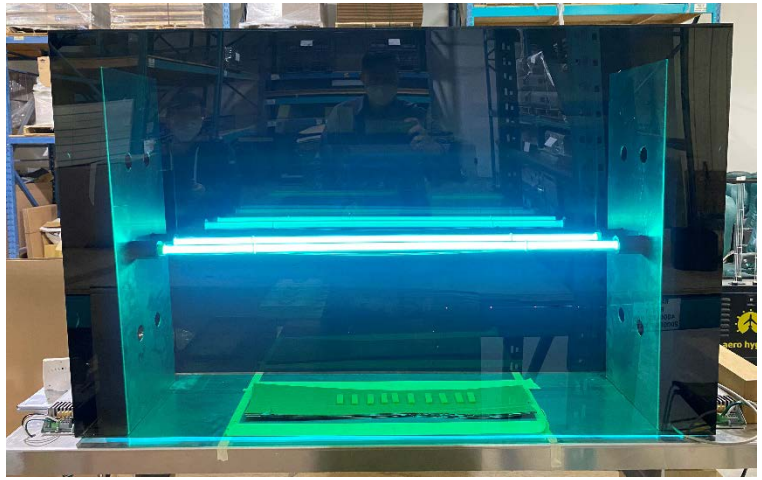
UV-C Source: Rayonet Photoreactor



Average Intensity (mW/cm^2)	Cumulative Time (Years)	Cumulative Dosage (mJ/cm^2)	Exposure Duration (minutes)
13.2	One	14600	18.4
	Four	58400	73.6
	Eight	116800	147.2

UV-C Source: LightTech



Average Intensity (mW/cm^2)	Cumulative Time (Years)	Cumulative Dosage (mJ/cm^2)	Exposure Duration (minutes)
5.28	One	14600	46
	Four	58400	184
	Eight	116800	368

Single Treatment Dose: 40 mJ/cm^2 [3]

[3] International Ultraviolet Association, Advice for the selection and operation of equipment for the UV disinfection of air and surfaces.

Wavelength Configuration: 280 nm

Effects of Ultraviolet-C Irradiation on Aircraft Cabin Interiors

UV-C Source: Aquisense 24G UVinaire

Single Treatment Dose: 37.5 mJ/cm^2 [4]

Average Intensity (mW/cm^2)	Cumulative Time (Years)	Cumulative Dosage (mJ/cm^2)	Exposure Duration (minutes)
10.14	One	13687.5	22.5
	Four	54750	90
	Eight	109500	180

[4] Inagaki, Hiroko et al, Rapid inactivation of SARS-CoV-2 with deep-UV LED irradiation, Emerging Microbes & Infections, 2020.

Mechanical Test Setup

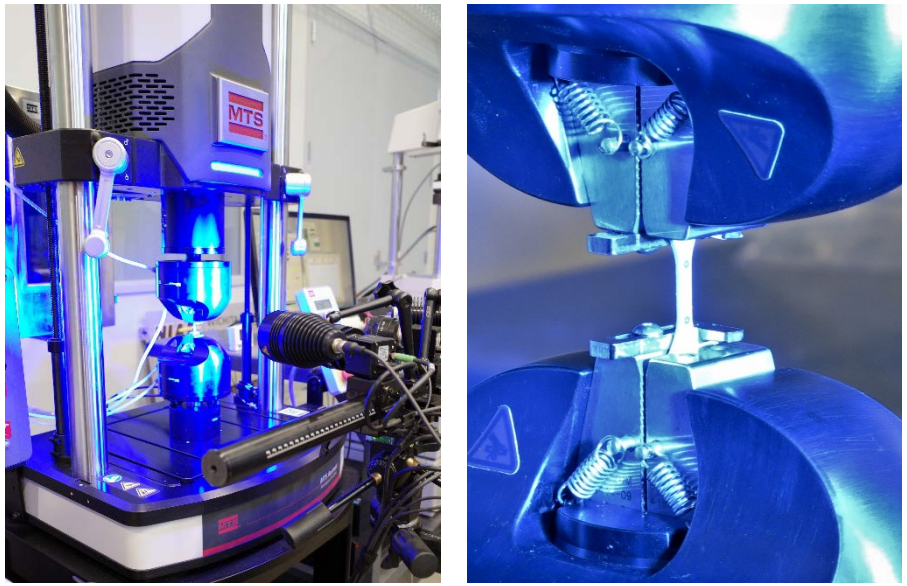
Effects of Ultraviolet-C Irradiation on Aircraft Cabin Interiors

Experiment: Tension

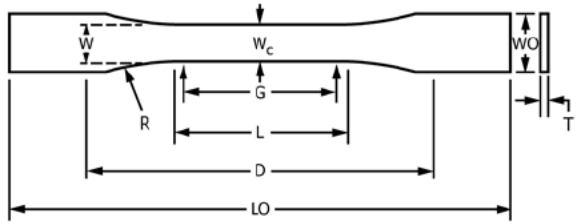
Mechanical Test Setup

- Mechanical Test Method: Uniaxial tensile experiments
- Test Standard: ASTM D638
- Test Equipment: MTS electrodynamic test frame
- Instrumentation: DIC for elongation measurements

Tensile Test Setup



Test Coupon Nominal Dimensions



Length Overall [LO], in	2.500
Length of Narrow Section [L], in	0.375
Gage Length [G], in	0.300
Width Overall [WO], in	0.375
Width Narrow Section [W], in	0.125
Distance Between Grips [D], in	1.000
Radius of Fillet [R], in	0.500

Test Coupon With Stickers For DIC

Tensile Test Matrix

Plastic Type	Wavelength Configuration						
	222 nm		253.4 nm			280 nm	
	Cumulative Time (Years)						
	Four	Eight	One	Four	Eight	Four	Eight
Kydex 6565	x 3	x 3	x 3	x 3	x 3	x 3	x 3
Boltaron 9815E	x 3	x 3	x 3	x 3	x 3	x 3	x 3
Lexan XHR	x 3	x 3	x 3	x 3	x 3	x 3	x 3
Boltaron 9815N	x 3	x 3	x 3	x 3	x 3	x 3	x 3
Ultem 9075	x 3	x 3	-	x 3	x 3	x 3	x 3
Ultem 9085	x 3	x 3	-	x 3	x 3	x 3	x 3

Experiment: Flexure

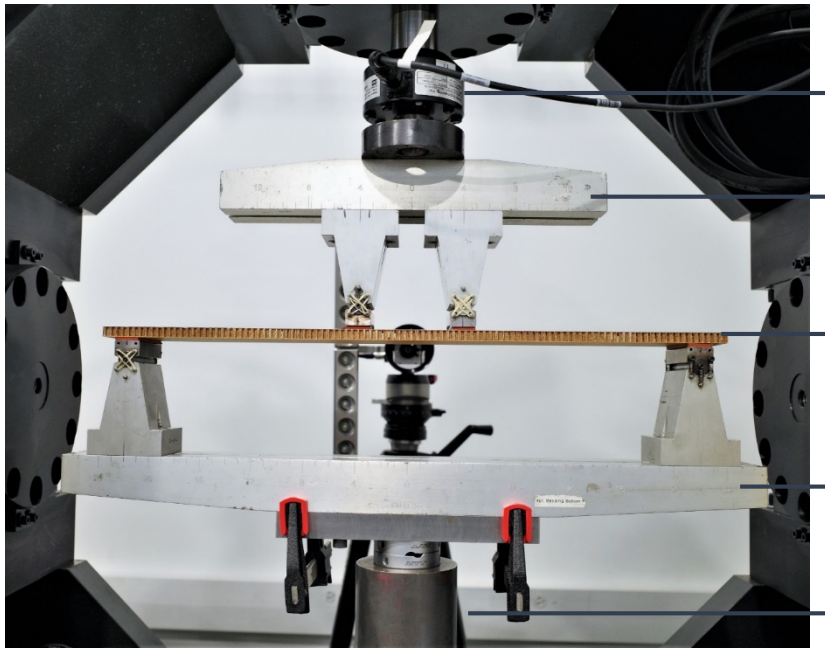
Mechanical Test Setup

- Mechanical Test Method: Flexure
- Test Standard: ASTM D7249
- Test Equipment: MTS electrodynamic test frame

Flexure Test Matrix

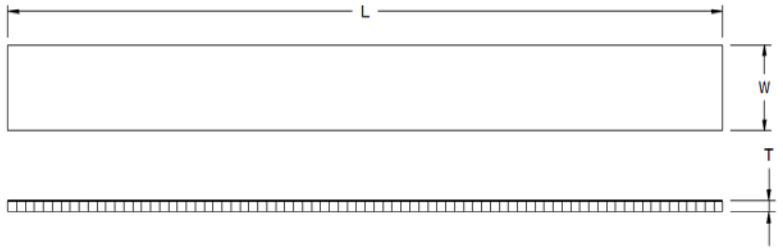
Specimen Type	Wavelength Configuration								
	222 nm			253.4 nm			280 nm		
	Cumulative Time (Years)								
	One	Four	Eight	One	Four	Eight	One	Four	Eight
Honeycomb [Nomex core with fiberglass/phenolic resin]	x 3	x 3	x 3	x 3	x 3	x 3	x 3	x 3	x 3

Flexure Test Setup



Test Coupon Nominal Dimensions

Overall length [L], in	24.0
Overall width [W], in	3.0
Panel thickness [T], in	0.4



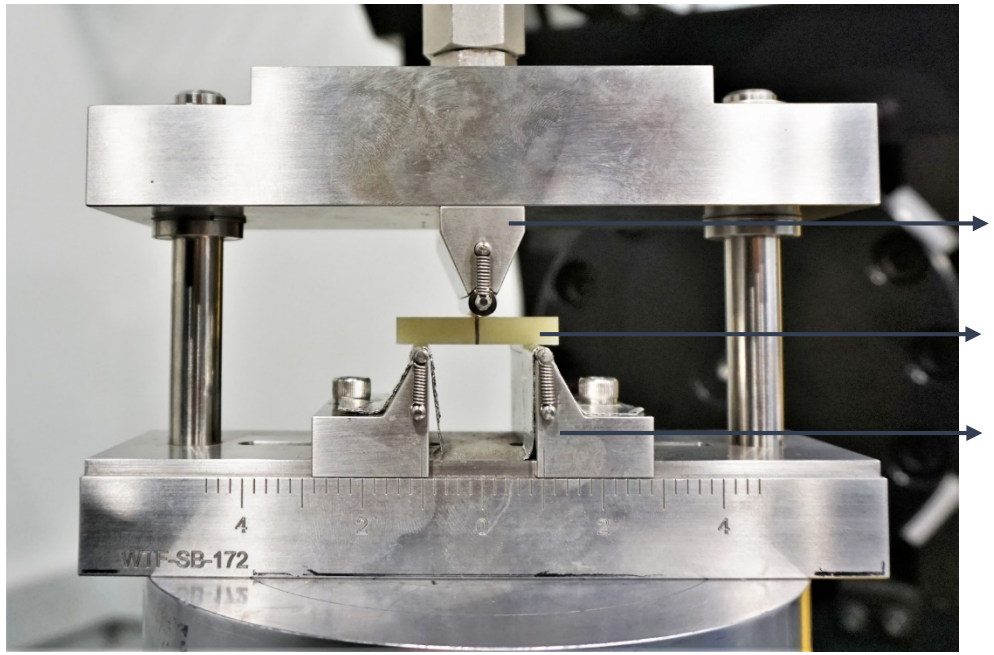
Experiment: Short Beam Shear

Mechanical Test Setup

- Mechanical Test Method: Short beam shear
- Test Standard: ASTM D2344
- Test Equipment: MTS electrodynamic test frame

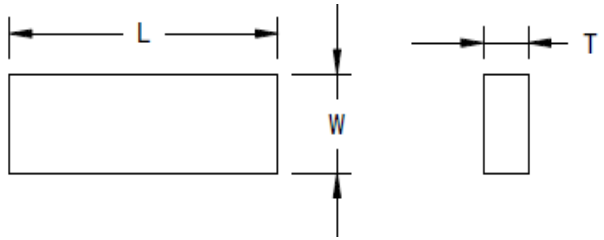
Short Beam Shear Test Matrix									
Specimen Type	Wavelength Configuration								
	222 nm			253.4 nm			280 nm		
	Cumulative Time (Years)								
	One	Four	Eight	One	Four	Eight	One	Four	Eight
Fiberglass G-10/FR4	x 3	x 3	x 3	x 3	x 3	x 3	x 3	x 3	x 3

Short Beam Shear Test Setup



Test Coupon Nominal Dimensions

Overall length [L], in	1.50
Overall width [W], in	0.50
Panel thickness [T], in	0.25



Results & Discussion

Effects of Ultraviolet-C Irradiation on Aircraft Cabin Interiors

Kydex 6565: Color Evaluation

Results & Discussion

Pristine

222nm; 4,380 mJ/cm^2

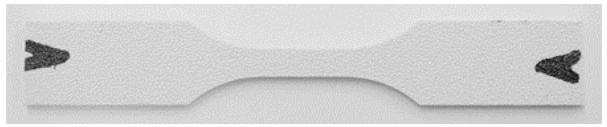
253.4 nm; 14,600 mJ/cm^2

280 nm; 54,750 mJ/cm^2

222 nm; 8,760 mJ/cm^2

253.4 nm; 58,400 mJ/cm^2

280 nm; 109,500 mJ/cm^2

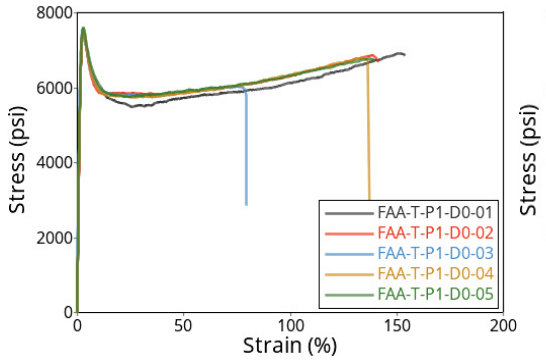


253.4 nm; 116,800 mJ/cm^2

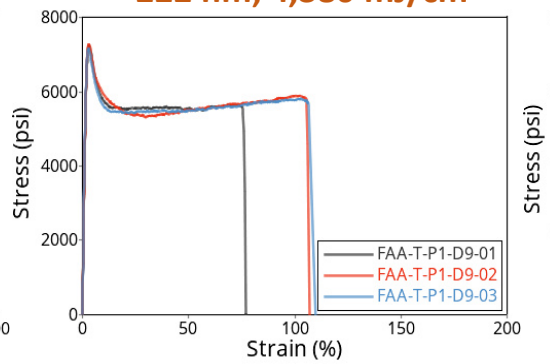
Kydex 6565: Mechanical Properties

Results & Discussion

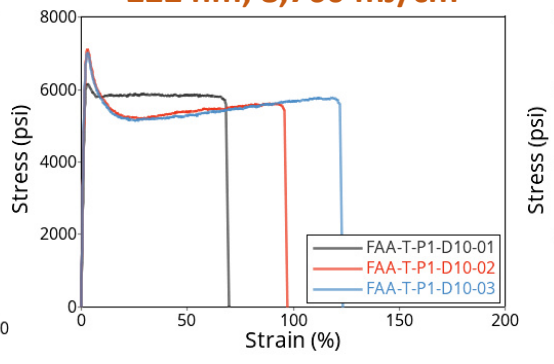
Pristine



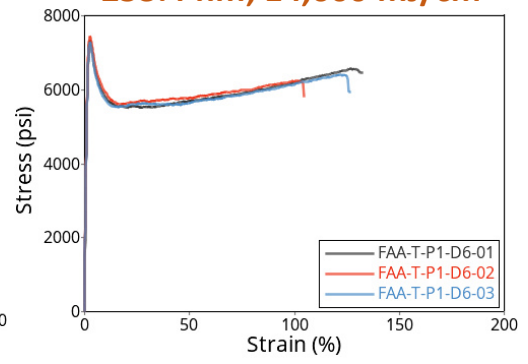
222 nm; 4,380 mJ/cm²



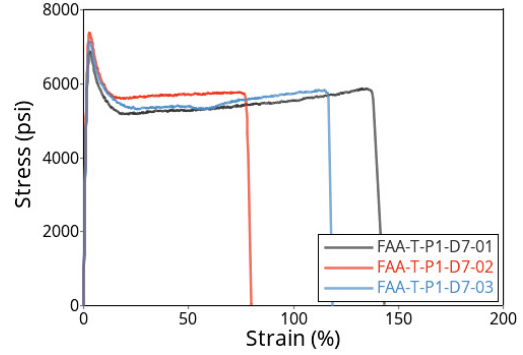
222 nm; 8,760 mJ/cm²



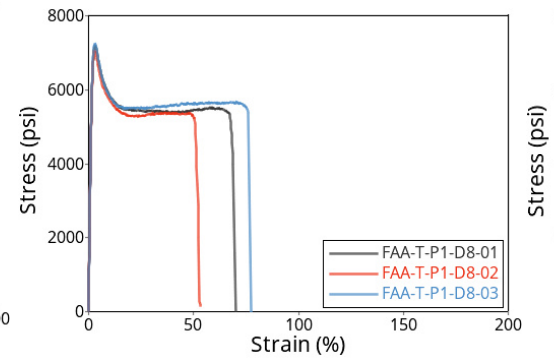
253.4 nm; 14,600 mJ/cm²



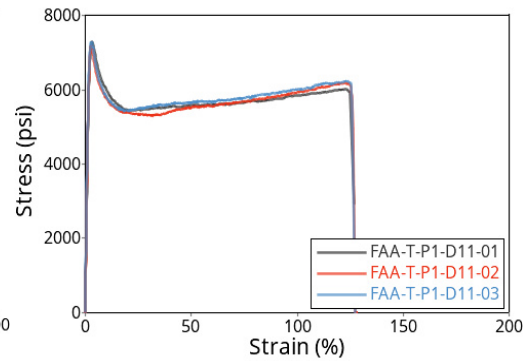
253.4 nm; 58,400 mJ/cm²



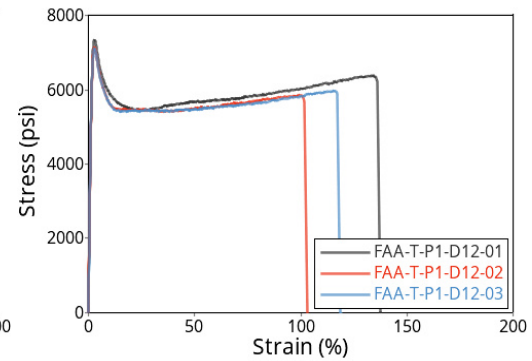
253.4 nm; 116,800 mJ/cm²



280 nm; 54,750 mJ/cm²

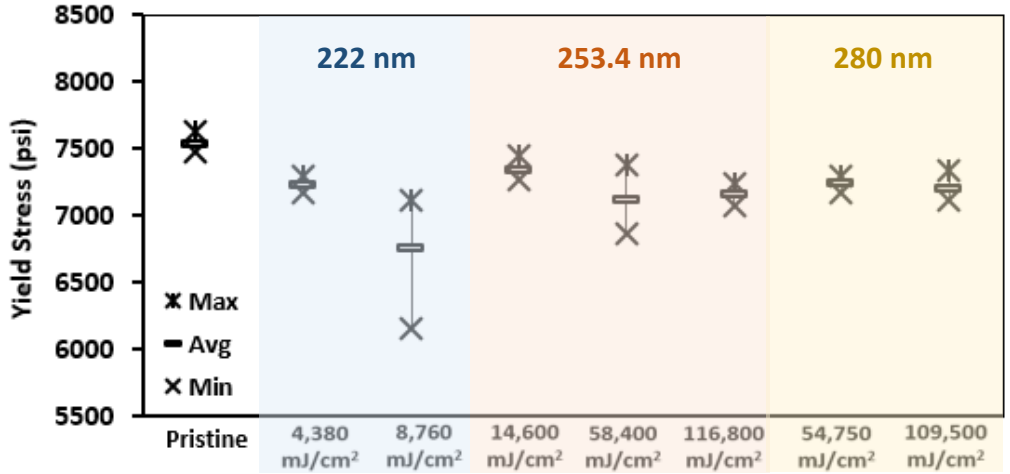


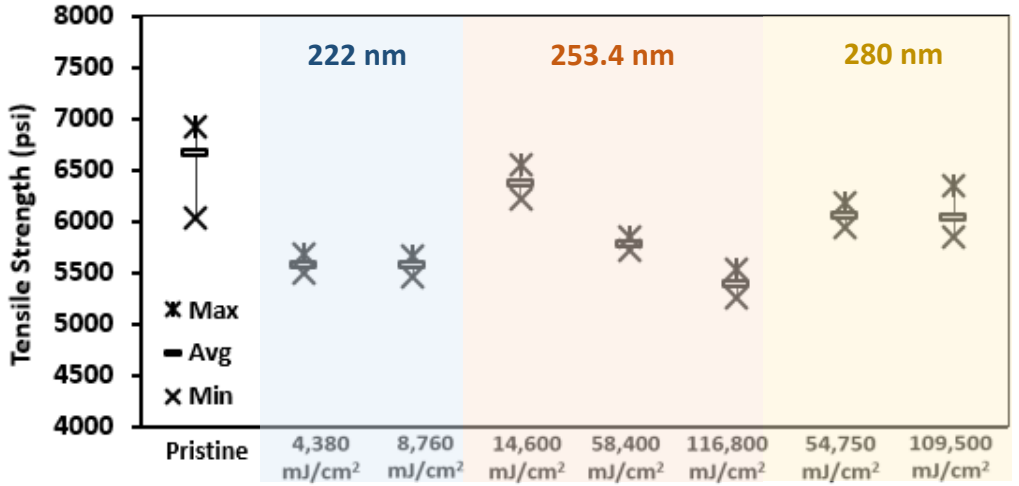
280 nm; 109,500 mJ/cm²

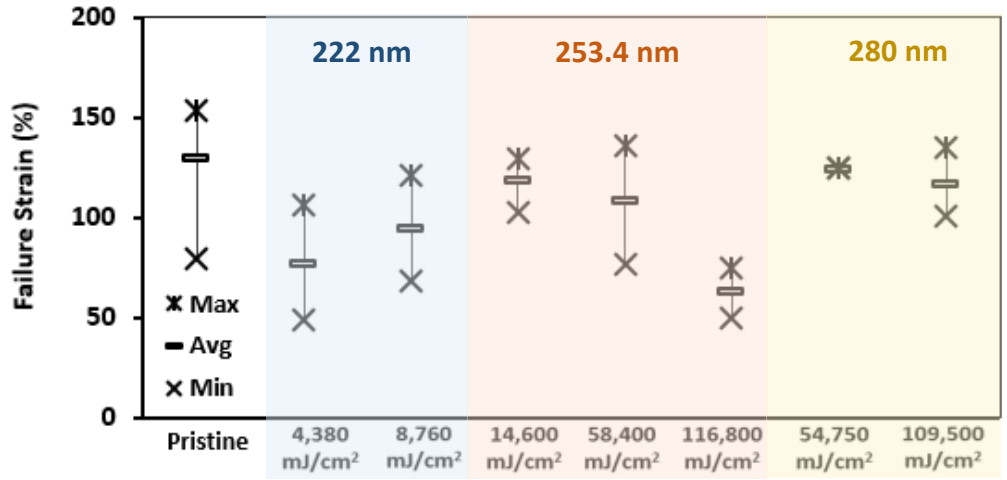


Kydex 6565: Test Data Comparison

Results & Discussion







Boltaron 9815E: Color Evaluation

Results & Discussion

Pristine

222nm; 4,380 mJ/cm^2

253.4 nm; 14,600 mJ/cm^2

280 nm; 54,750 mJ/cm^2

222 nm; 8,760 mJ/cm^2

253.4 nm; 58,400 mJ/cm^2

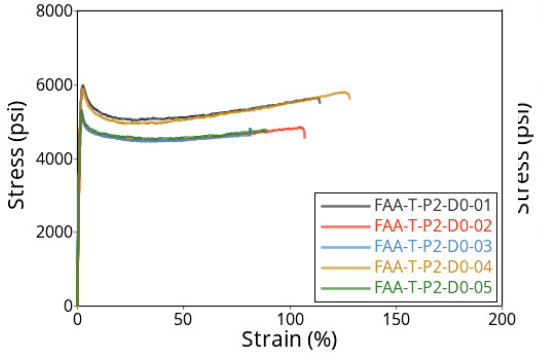
280 nm; 109,500 mJ/cm^2

253.4 nm; 116,800 mJ/cm^2

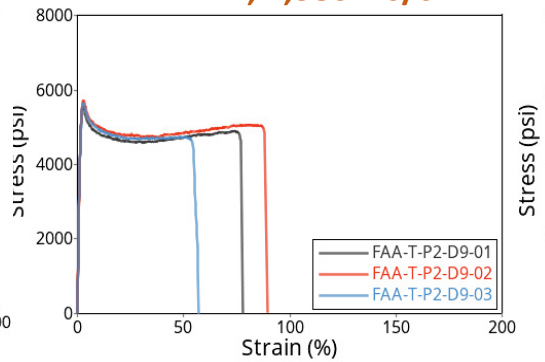
Boltaron 9815E: Mechanical Properties

Results & Discussion

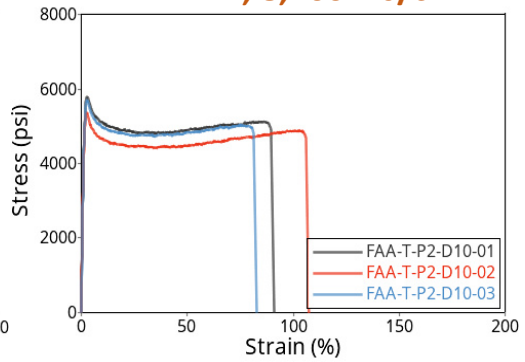
Pristine



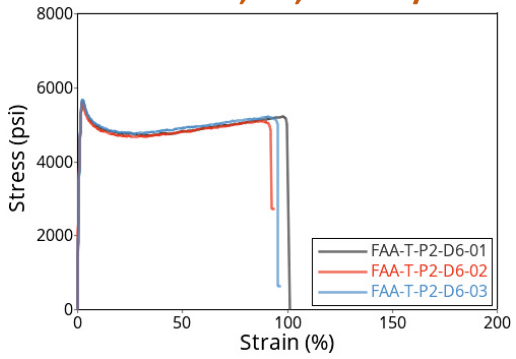
222 nm; 4,380 mJ/cm²



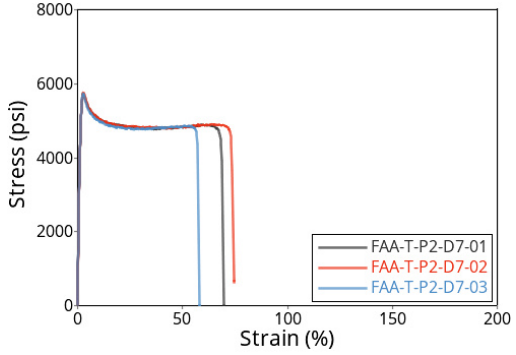
222 nm; 8,760 mJ/cm²



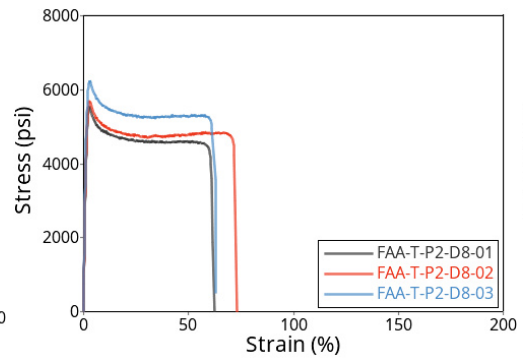
253.4 nm; 14,600 mJ/cm²



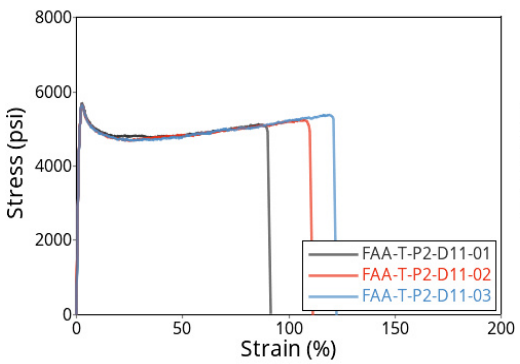
253.4 nm; 58,400 mJ/cm²



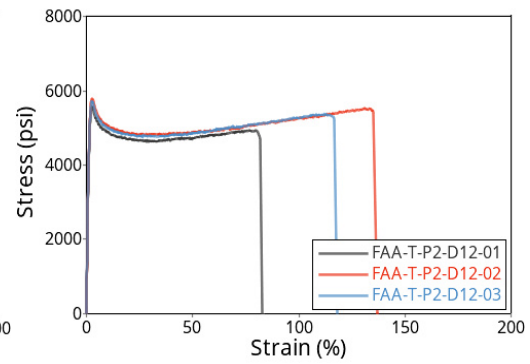
253.4 nm; 116,800 mJ/cm²



280 nm; 54,750 mJ/cm²

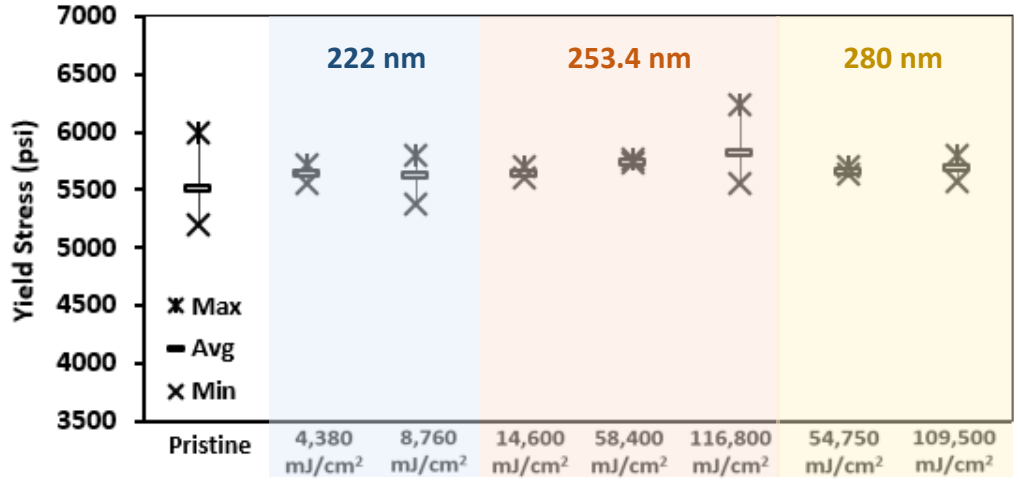


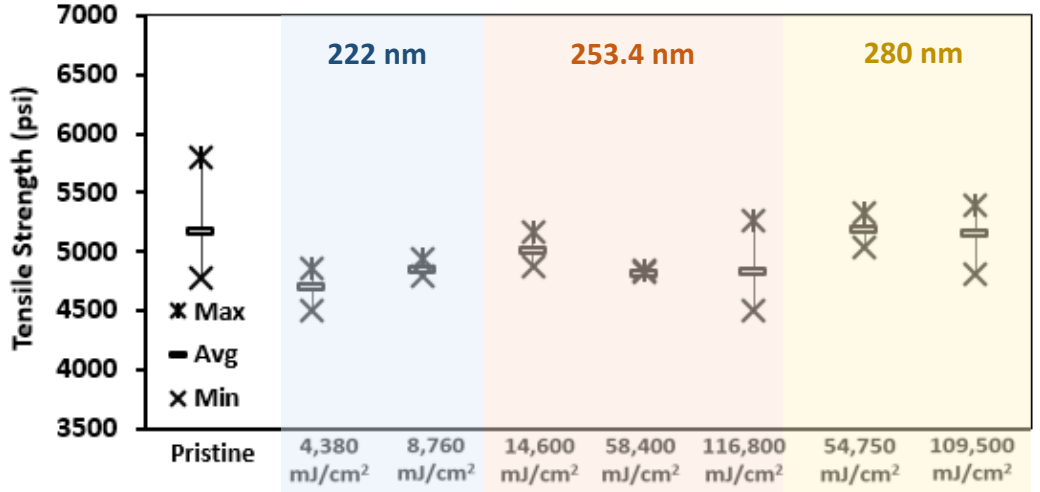
280 nm; 109,500 mJ/cm²

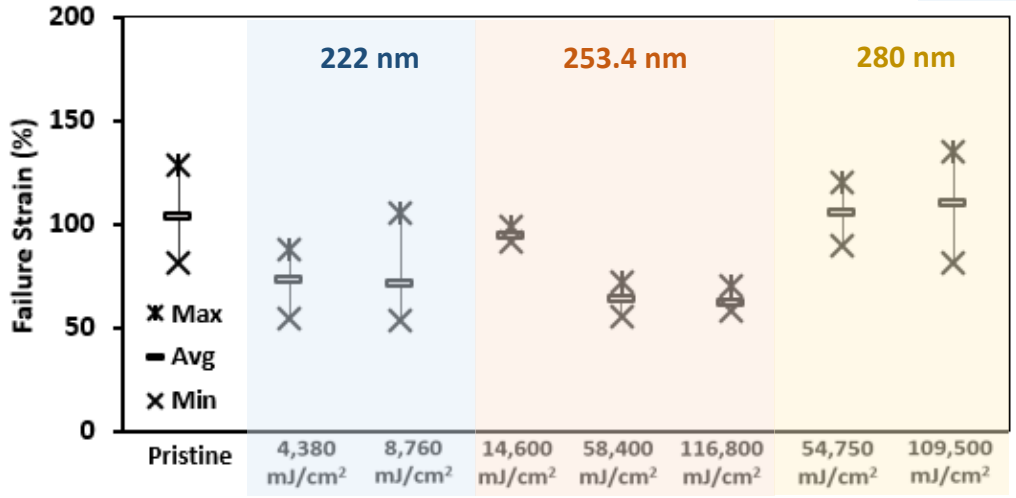


Boltaron 9815E: Test Data Comparison

Results & Discussion







Lexan XHR: Color Evaluation

Results & Discussion

Pristine

222nm; 4,380 mJ/cm^2

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280 nm; 54,750 mJ/cm^2

222 nm; 8,760 mJ/cm^2

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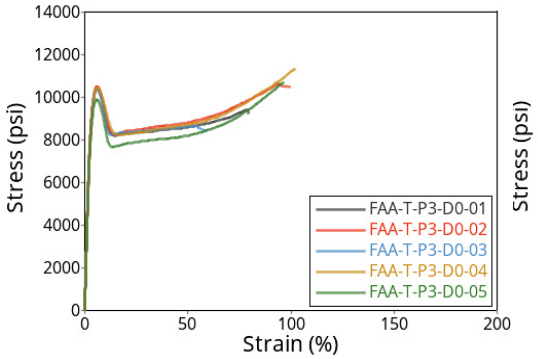
253.4 nm; 116,800 mJ/cm^2

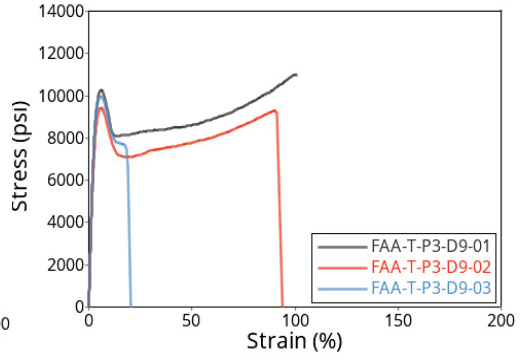
Lexan XHR: Mechanical Properties

Results & Discussion

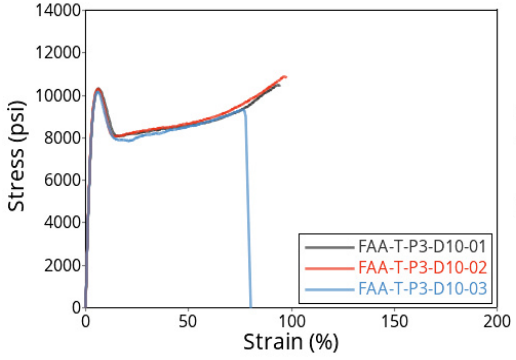
Pristine



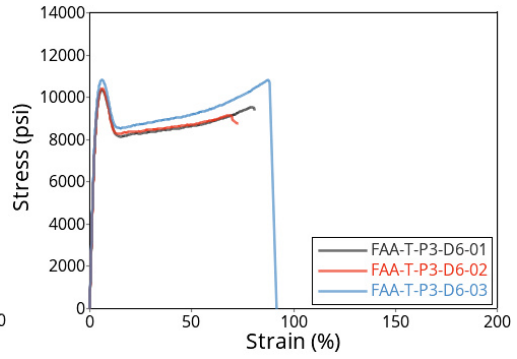
222 nm; 4,380 mJ/cm²



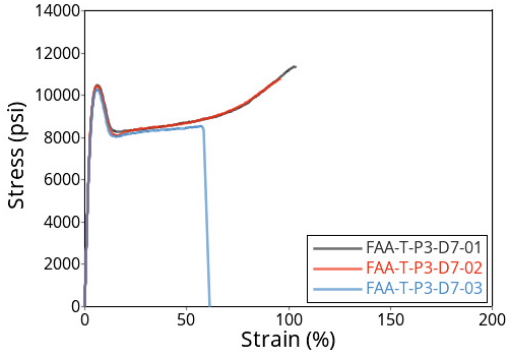
222 nm; 8,760 mJ/cm²



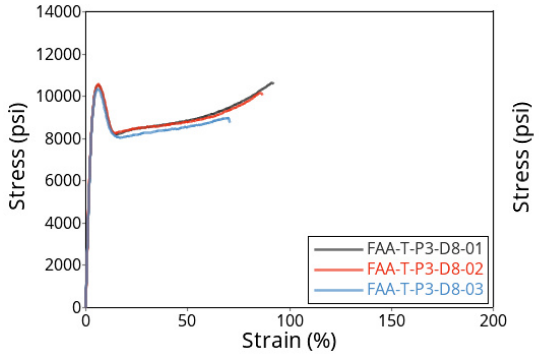
253.4 nm; 14,600 mJ/cm²



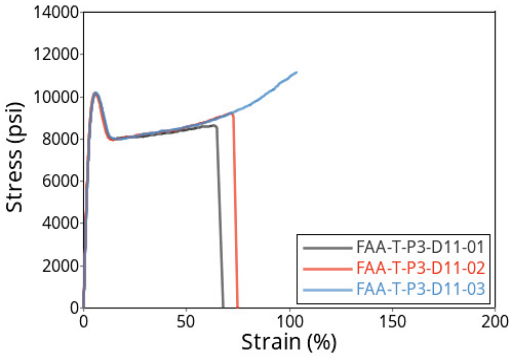
253.4 nm; 58,400 mJ/cm²



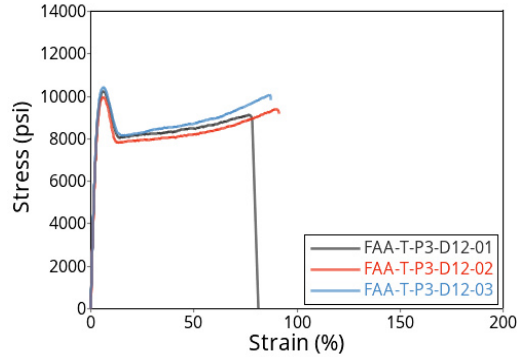
253.4 nm; 116,800 mJ/cm²



280 nm; 54,750 mJ/cm²

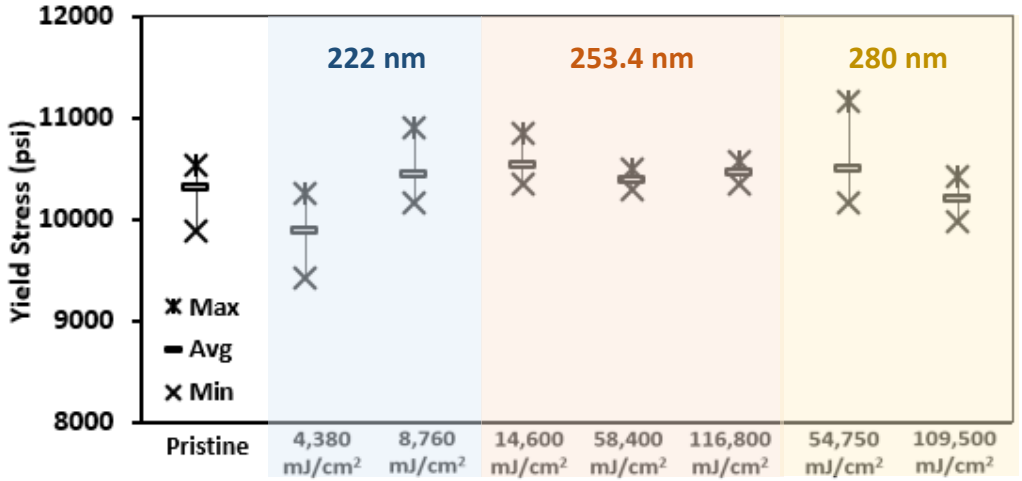


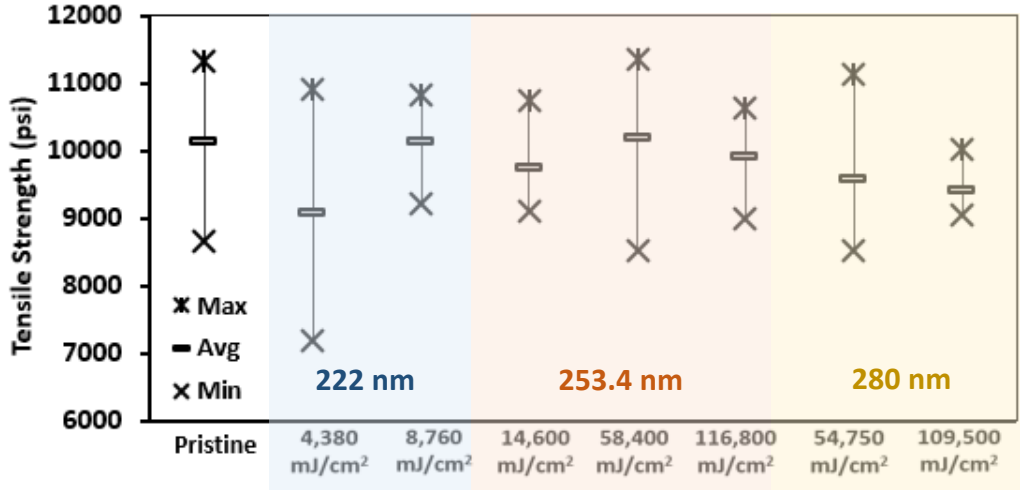
280 nm; 109,500 mJ/cm²

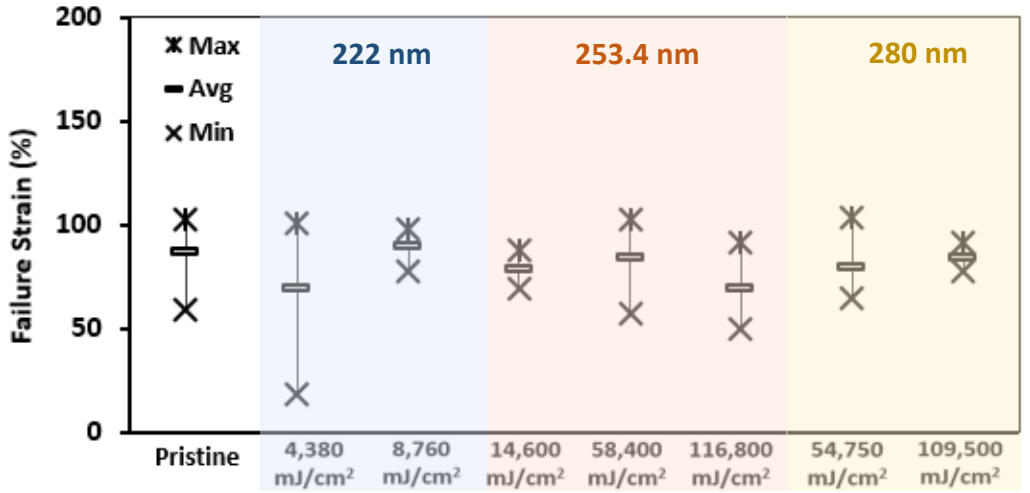


Lexan XHR: Test Data Comparison

Results & Discussion







Boltaron 9815N: Color Evaluation

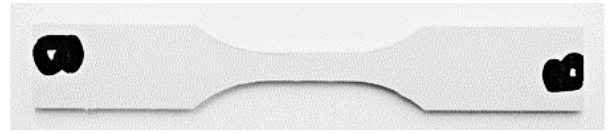
Results & Discussion

Pristine

222nm; 4,380 mJ/cm^2

253.4 nm; 14,600 mJ/cm^2

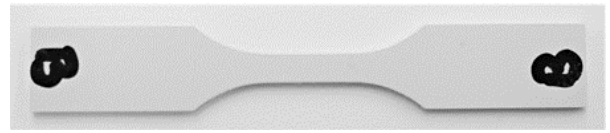
280 nm; 54,750 mJ/cm^2



222 nm; 8,760 mJ/cm^2

253.4 nm; 58,400 mJ/cm^2

280 nm; 109,500 mJ/cm^2

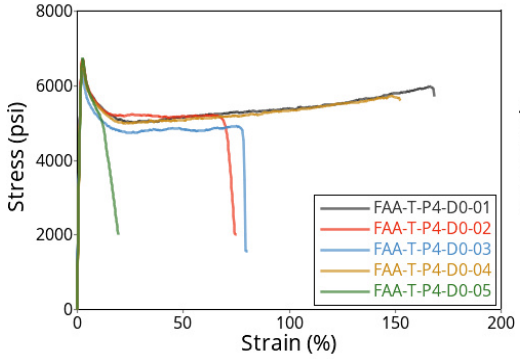


253.4 nm; 116,800 mJ/cm^2

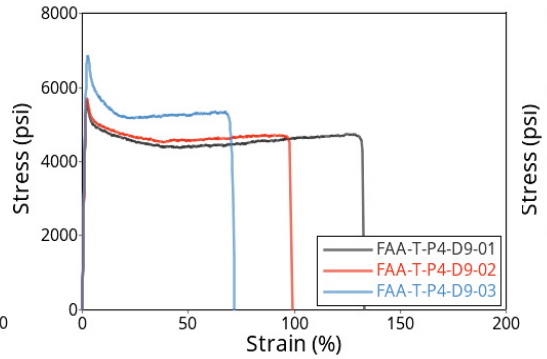
Boltaron 9815N: Mechanical Properties

Results & Discussion

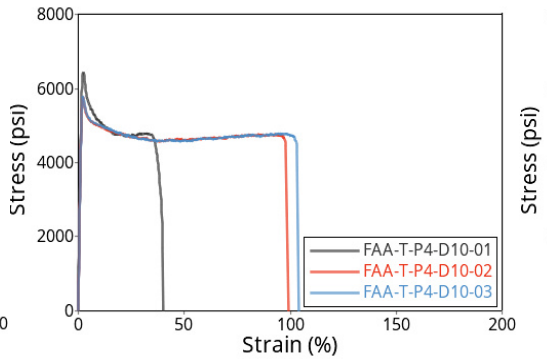
Pristine



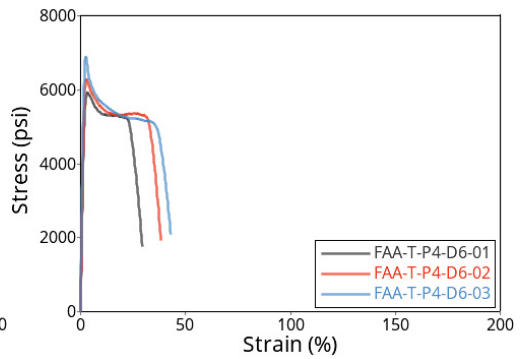
222 nm; 4,380 mJ/cm²



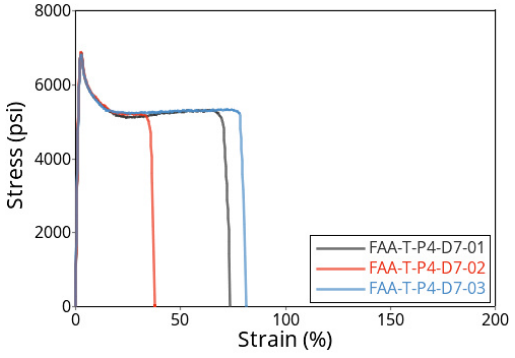
222 nm; 8,760 mJ/cm²



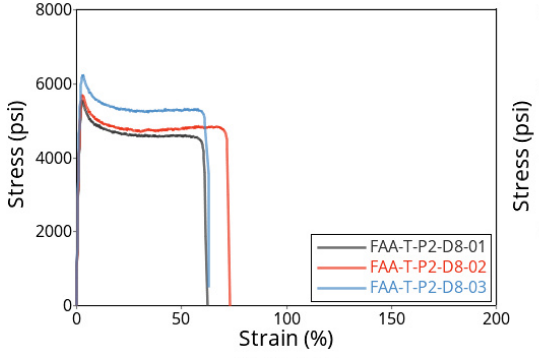
253.4 nm; 14,600 mJ/cm²



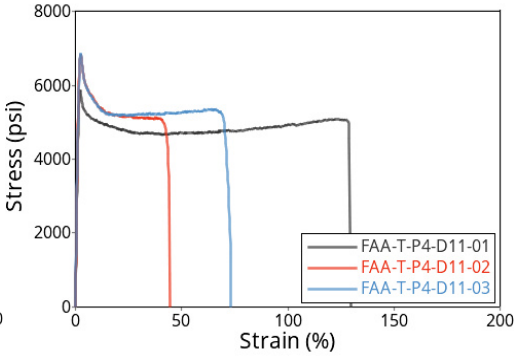
253.4 nm; 58,400 mJ/cm²



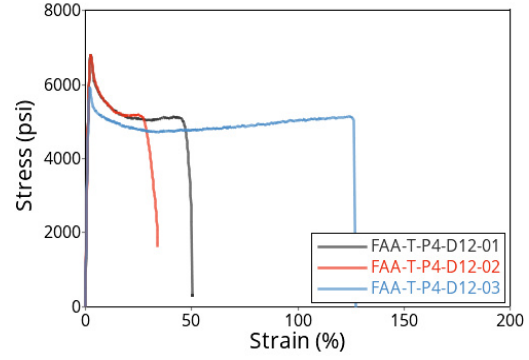
253.4 nm; 116,800 mJ/cm²



280 nm; 54,750 mJ/cm²

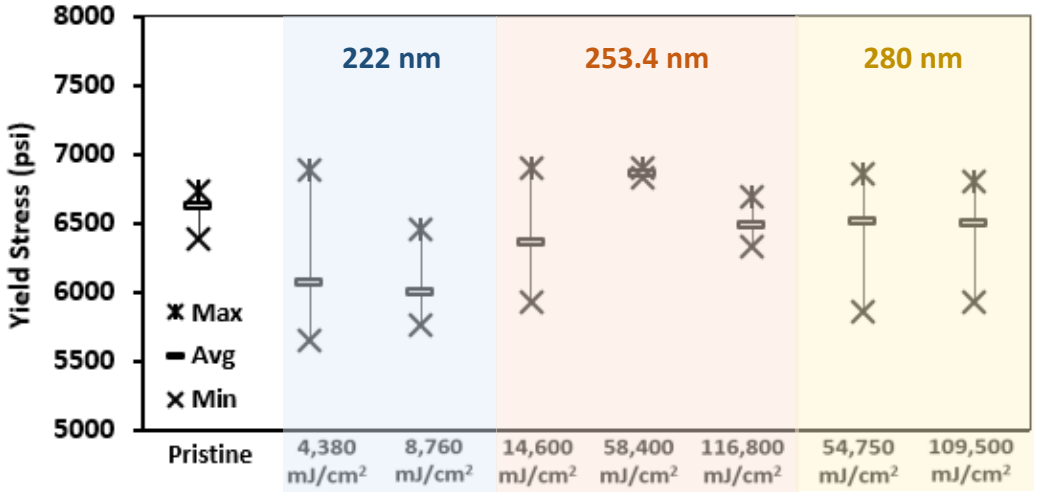


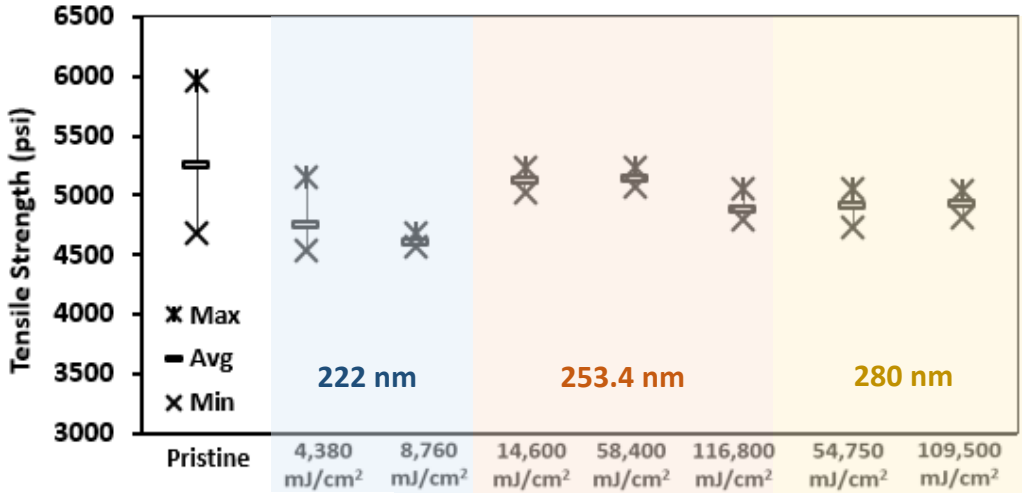
280 nm; 109,500 mJ/cm²

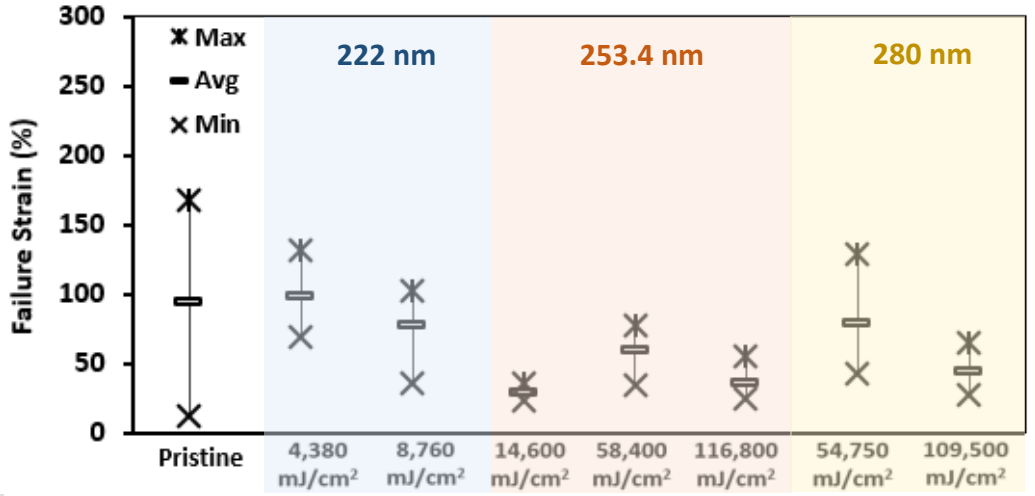


Boltaron 9815N: Test Data Comparison

Results & Discussion







Ultem 9075: Color Evaluation

Results & Discussion

Pristine

222nm; 4,380 mJ/cm^2

253.4 nm; 58,400 mJ/cm^2

280 nm; 54,750 mJ/cm^2

222 nm; 8,760 mJ/cm^2

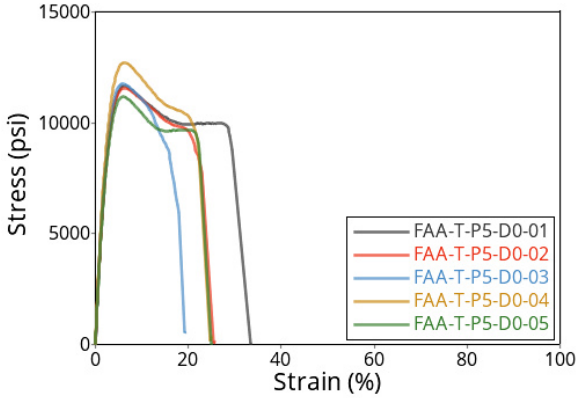
253.4 nm; 116,800 mJ/cm^2

280 nm; 109,500 mJ/cm^2

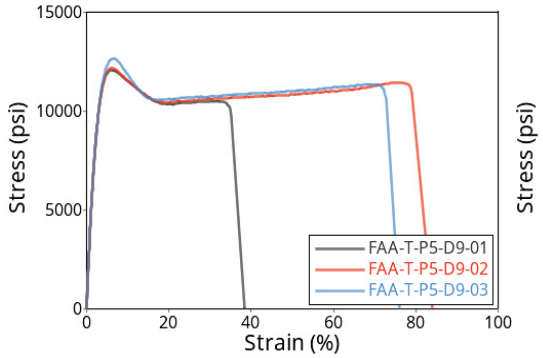
Ultem 9075: Mechanical Properties

Results & Discussion

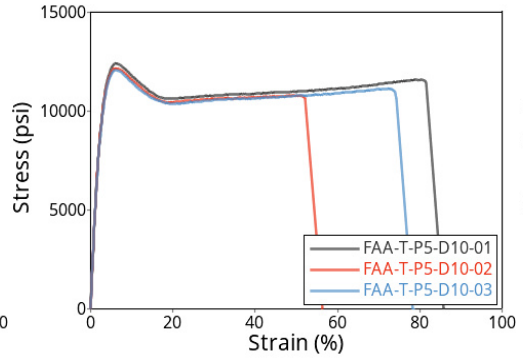
Pristine



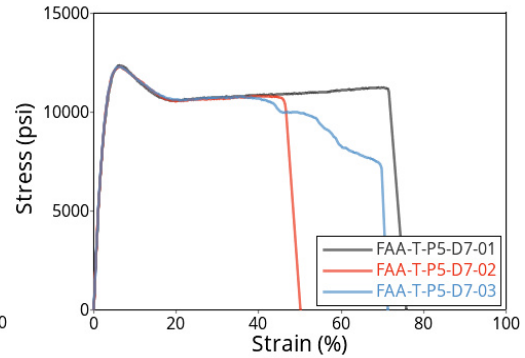
222 nm; 4,380 mJ/cm²



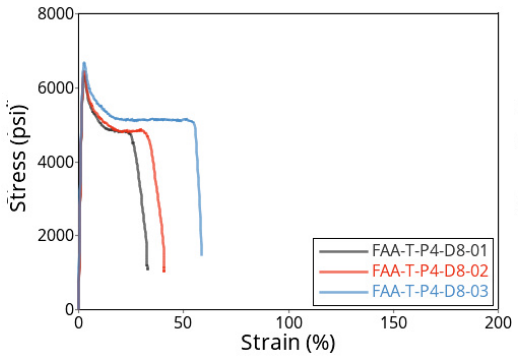
222 nm; 8,760 mJ/cm²



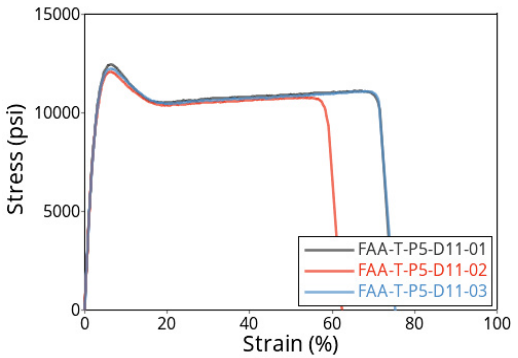
253.4 nm; 58,400 mJ/cm²



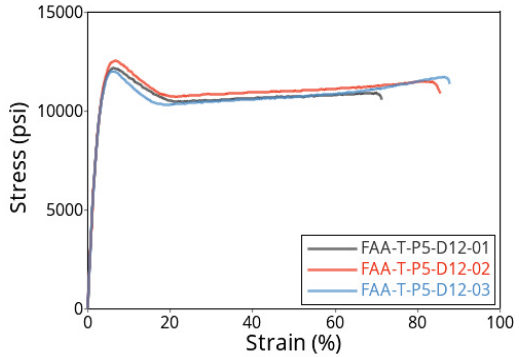
253.4 nm; 116,800 mJ/cm²



280 nm; 54,750 mJ/cm²

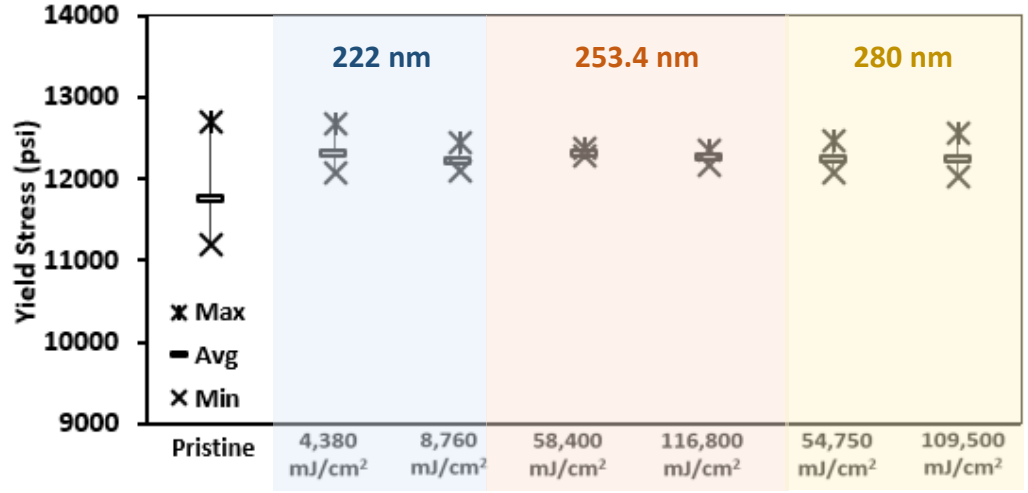


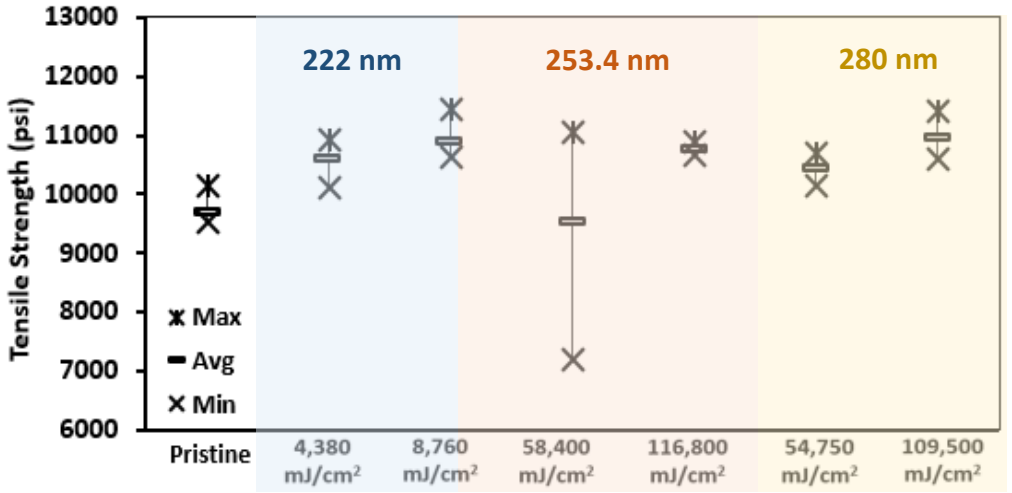
280 nm; 109,500 mJ/cm²

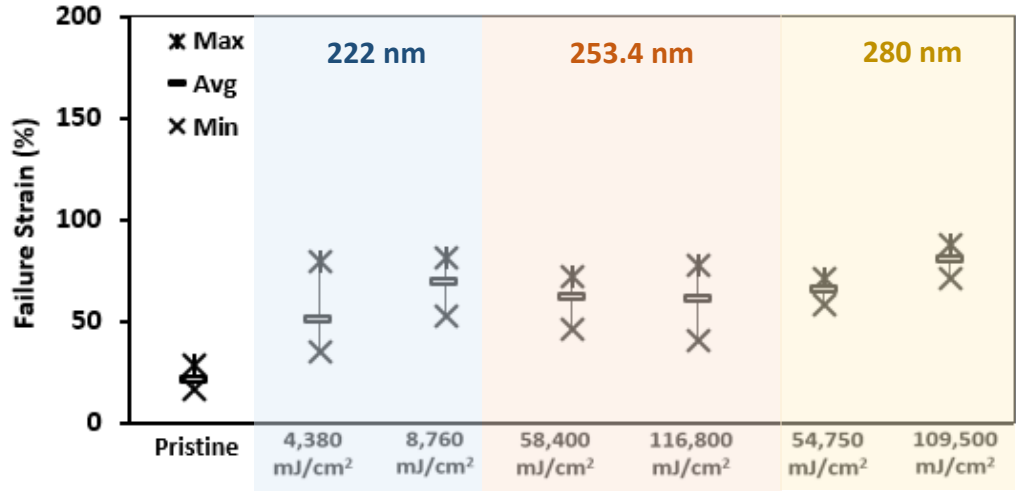


Ultem 9075: Test Data Comparison

Results & Discussion







Ultem 9085: Color Evaluation

Results & Discussion

Pristine

222nm; 4,380 mJ/cm^2

253.4 nm; 58,400 mJ/cm^2

280 nm; 54,750 mJ/cm^2

222 nm; 8,760 mJ/cm^2

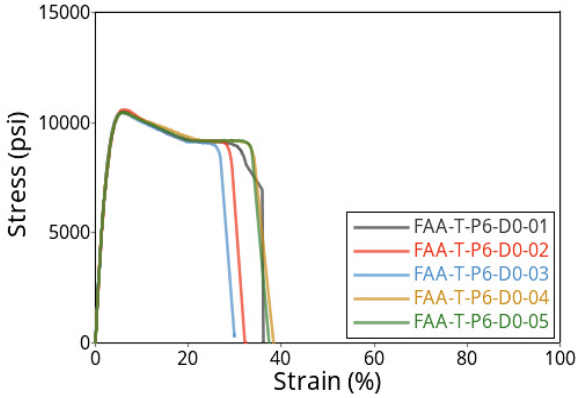
253.4 nm; 116,800 mJ/cm^2

280 nm; 109,500 mJ/cm^2

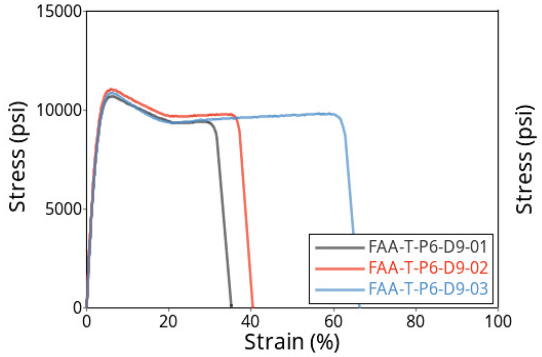
Ultem 9085: Mechanical Properties

Results & Discussion

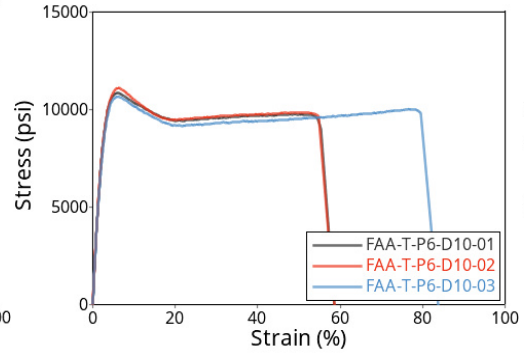
Pristine



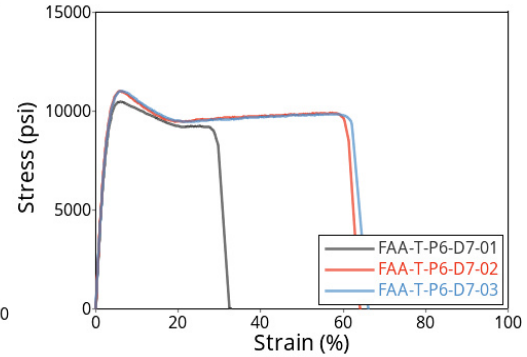
222 nm; 4,380 mJ/cm²



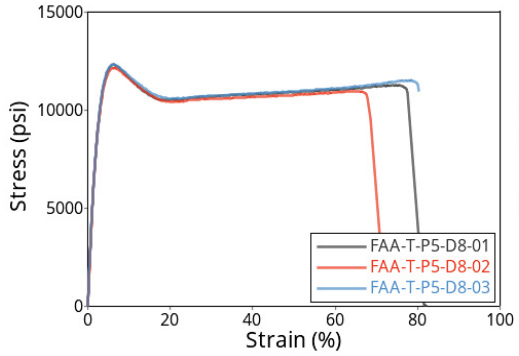
222 nm; 8,760 mJ/cm²



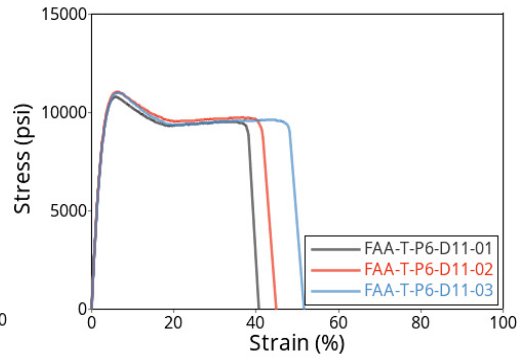
253.4 nm; 58,400 mJ/cm²



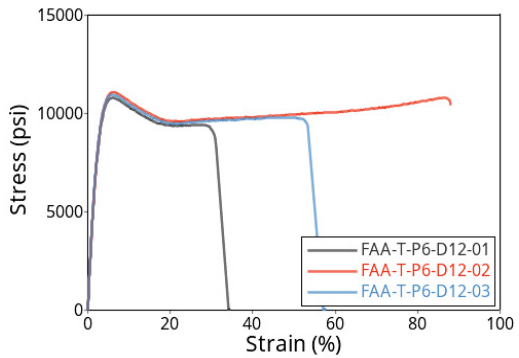
253.4 nm; 116,800 mJ/cm²



280 nm; 54,750 mJ/cm²

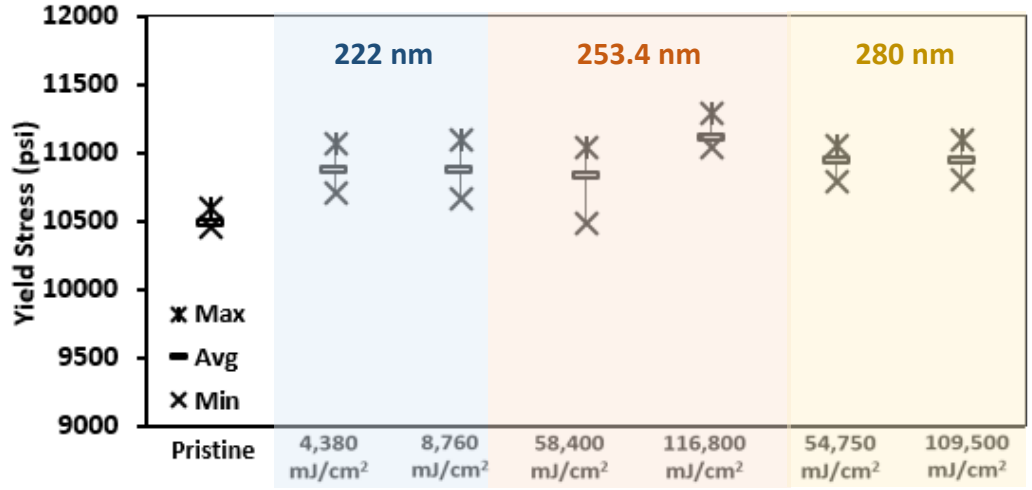


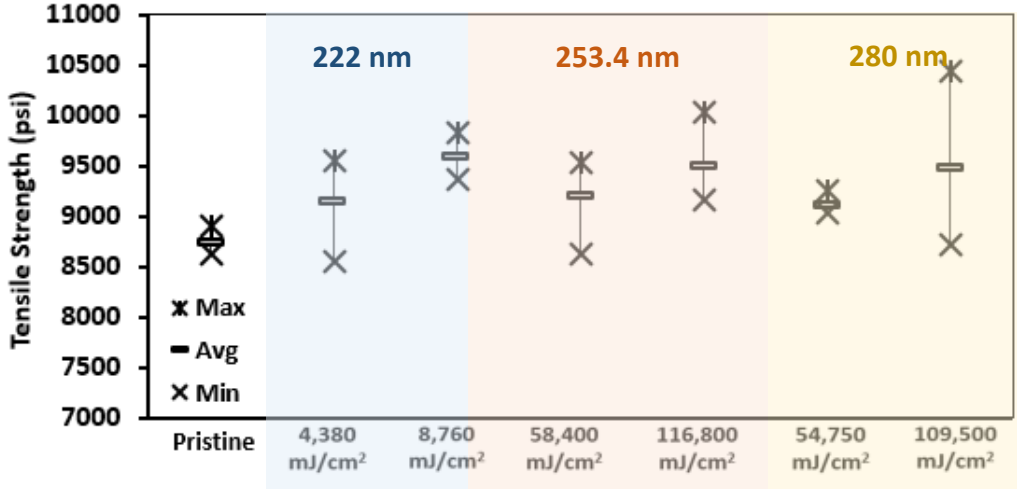
280 nm; 109,500 mJ/cm²

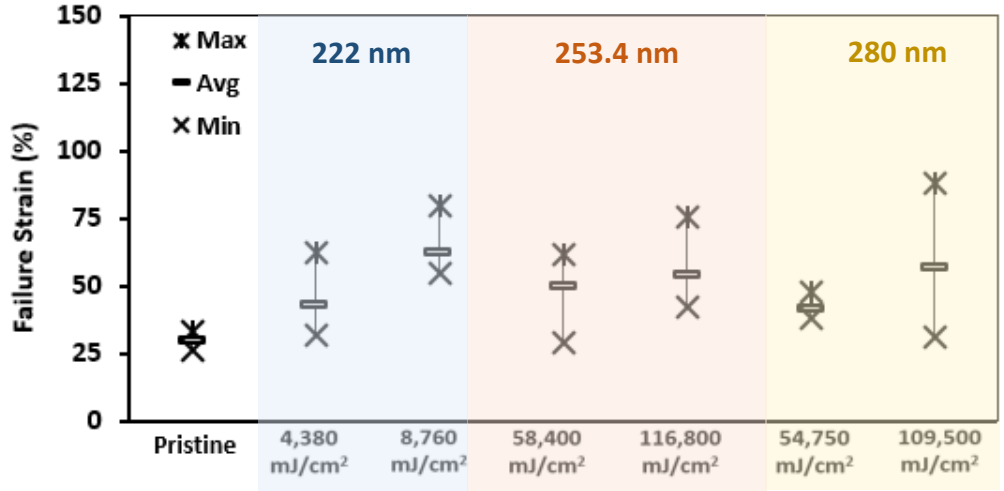


Ultem 9085: Test Data Comparison

Results & Discussion





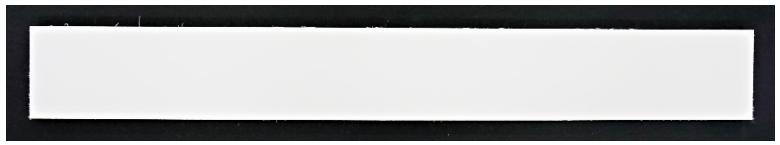


Honeycomb Type A: Color Evaluation

Results & Discussion

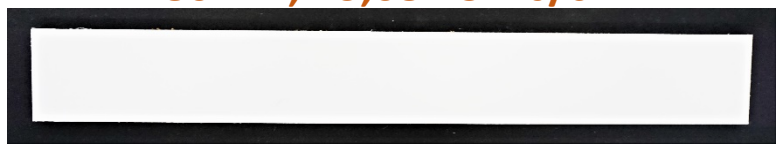
Pristine

222 nm; 1,095 mJ/cm^2



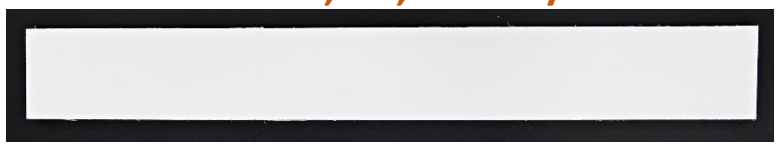
253.4 nm; 14,600 mJ/cm^2

280 nm; 13,687.5 mJ/cm^2

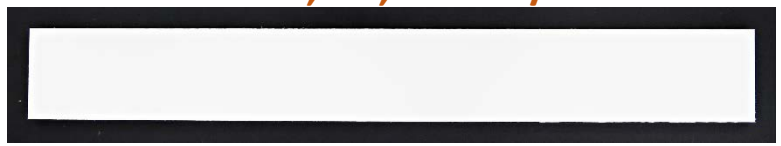


222 nm; 4,380 mJ/cm^2

253.4 nm; 58,400 mJ/cm^2



280 nm; 54,750 mJ/cm^2



222 nm; 8,760 mJ/cm^2

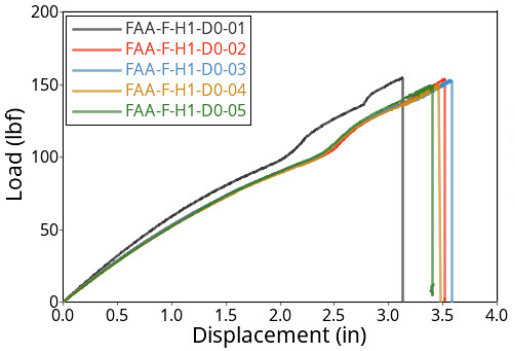
253.4 nm; 116,800 mJ/cm^2

253.4 nm; 109,500 mJ/cm^2

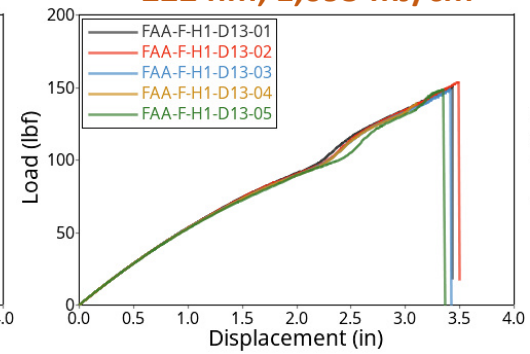
Honeycomb Type A: Mechanical Properties

Results & Discussion

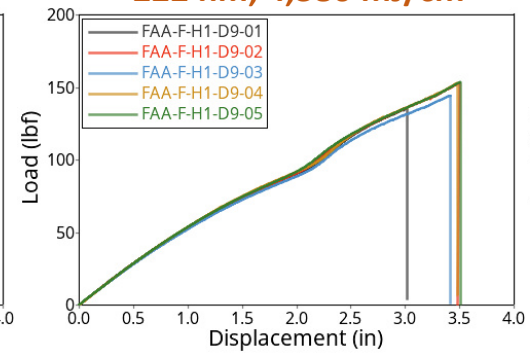
Pristine



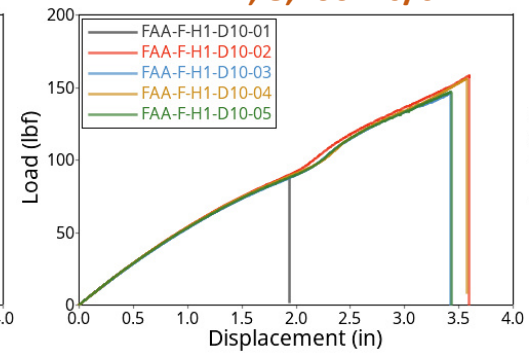
222 nm; 1,095 mJ/cm²



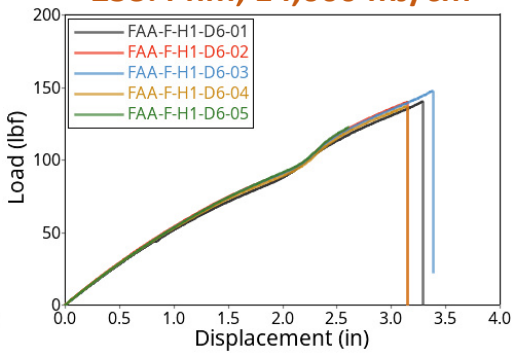
222 nm; 4,380 mJ/cm²



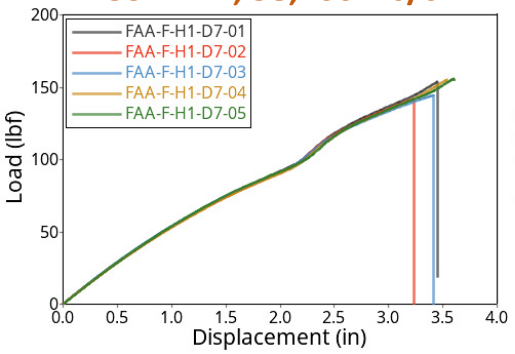
222 nm; 8,760 mJ/cm²



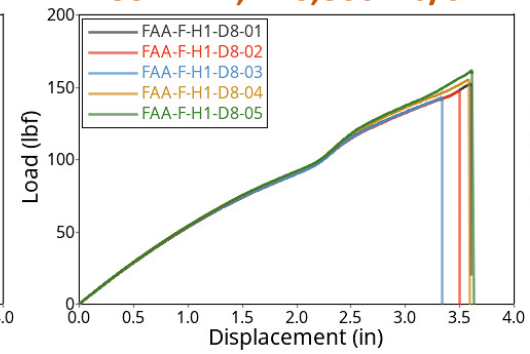
253.4 nm; 14,600 mJ/cm²



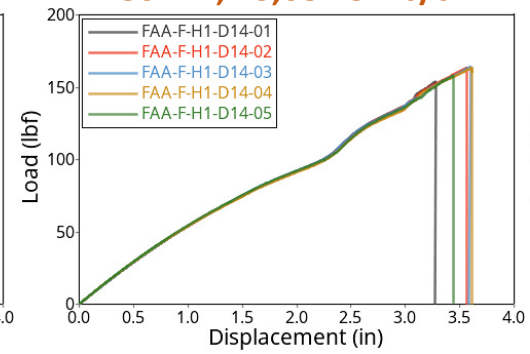
253.4 nm; 58,400 mJ/cm²



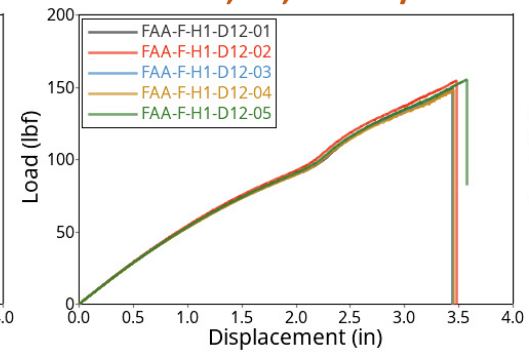
253.4 nm; 116,800 mJ/cm²



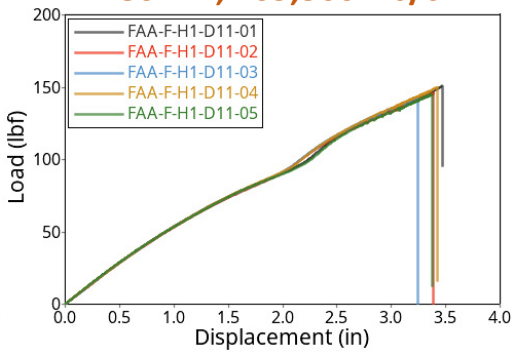
280 nm; 13,687.5 mJ/cm²



280 nm; 54,750 mJ/cm²

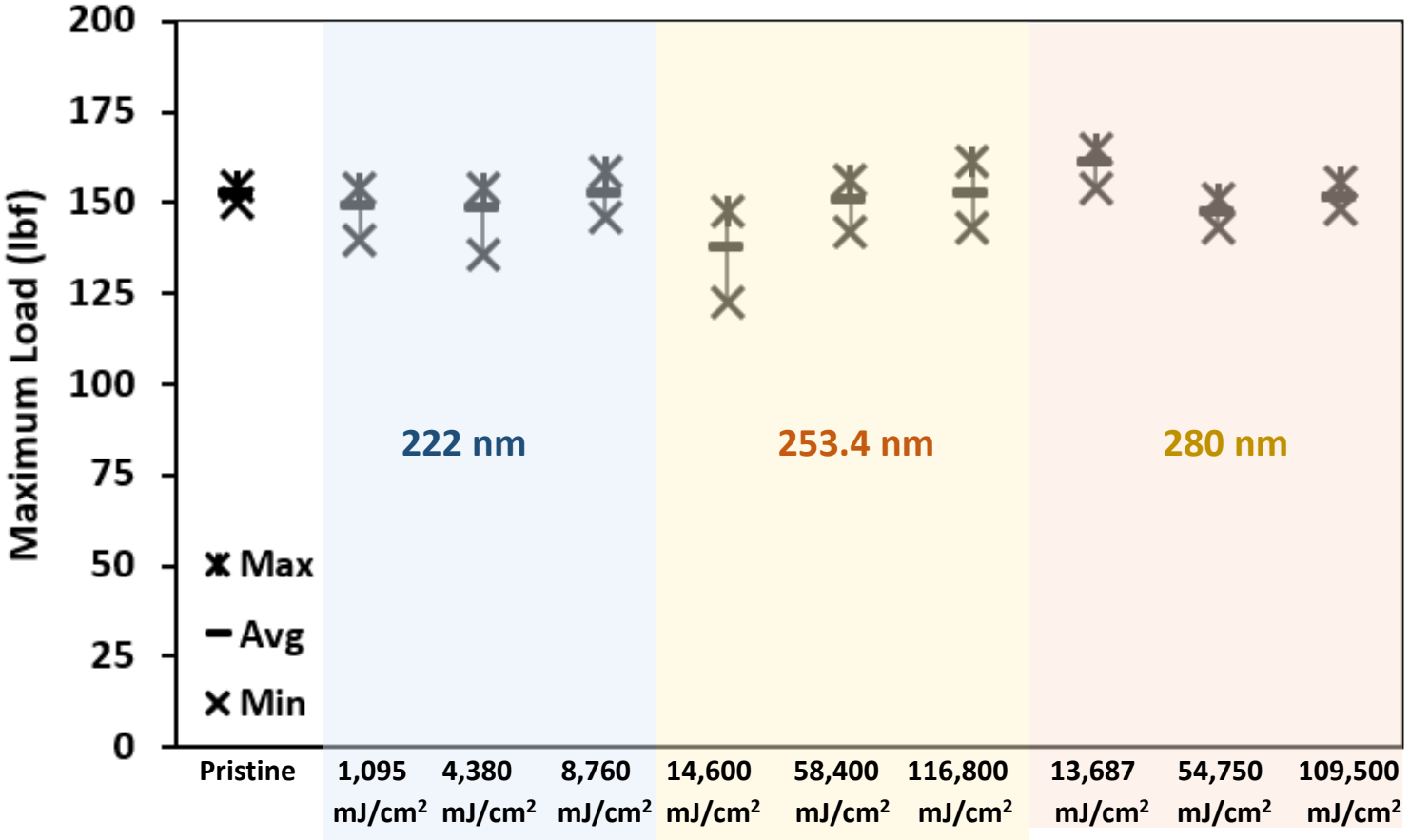


280 nm; 109,500 mJ/cm²



Honeycomb Type A: Test Data Comparison

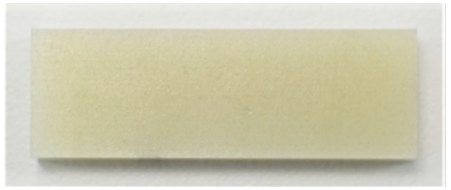
Results & Discussion



Fiberglass Laminate: Color Evaluation

Results & Discussion

Pristine

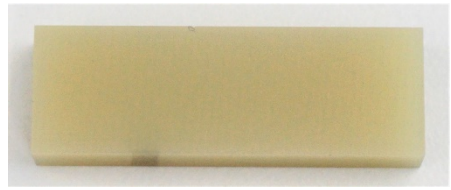


222 nm
1,095 mJ/cm^2

222 nm
4,380 mJ/cm^2

222 nm
8,760 mJ/cm^2

253.4 nm
14,600 mJ/cm^2



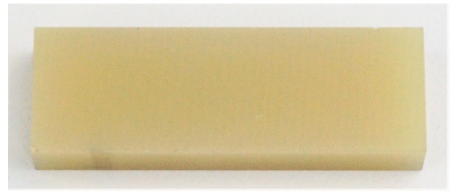
253.4 nm
58,400 mJ/cm^2

253.4 nm
116,800 mJ/cm^2

280 nm
13,687.5 mJ/cm^2

280 nm
54,750 mJ/cm^2

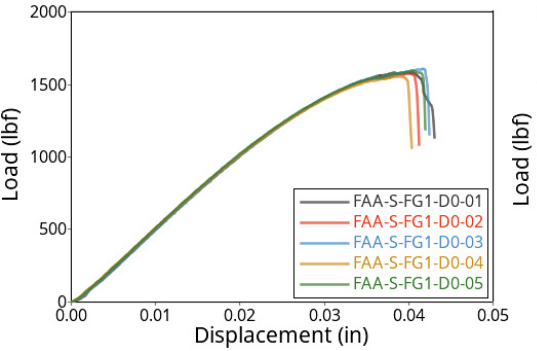
280 nm
109,500 mJ/cm^2



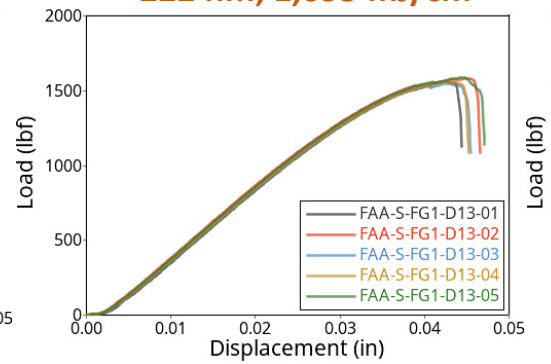
Fiberglass Laminate: Mechanical Properties

Results & Discussion

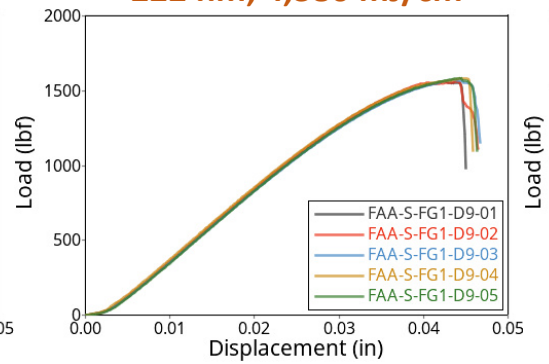
Pristine



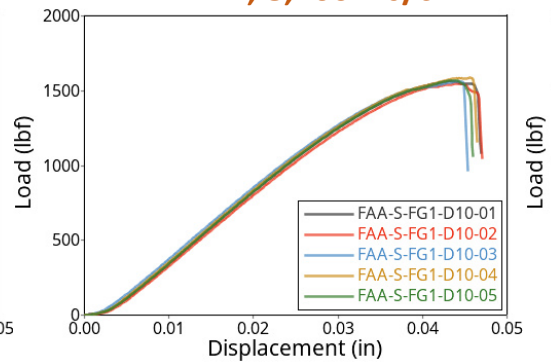
222 nm; 1,095 mJ/cm²



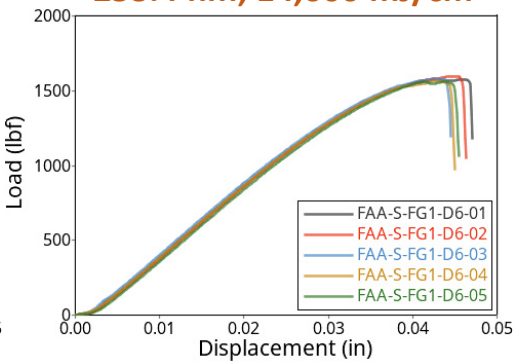
222 nm; 4,380 mJ/cm²



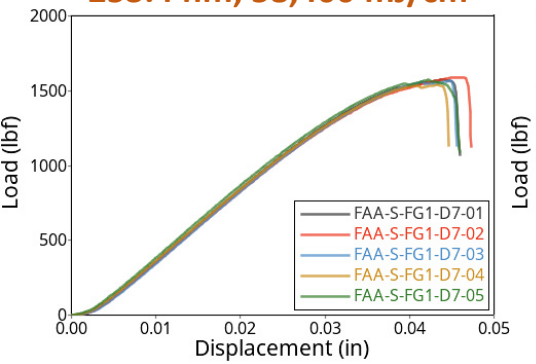
222 nm; 8,760 mJ/cm²



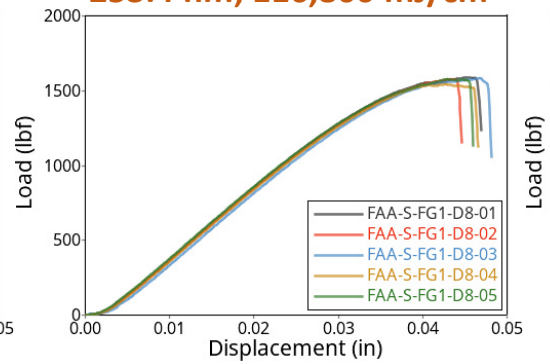
253.4 nm; 14,600 mJ/cm²



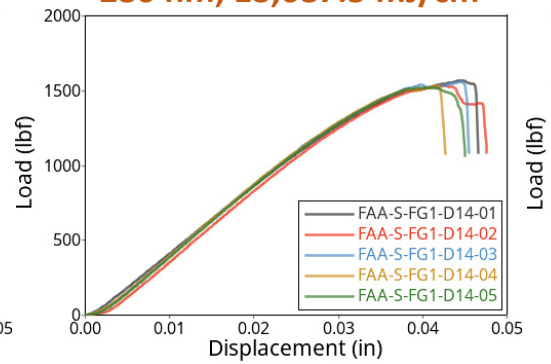
253.4 nm; 58,400 mJ/cm²



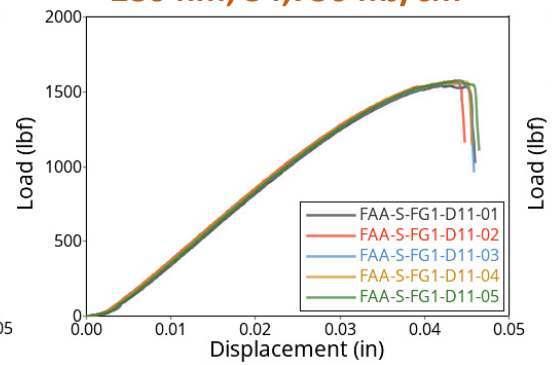
253.4 nm; 116,800 mJ/cm²



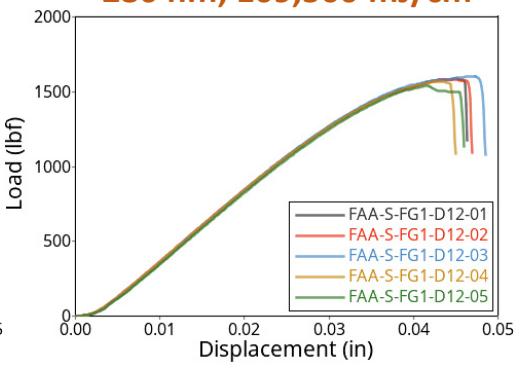
280 nm; 13,687.5 mJ/cm²



280 nm; 54,750 mJ/cm²

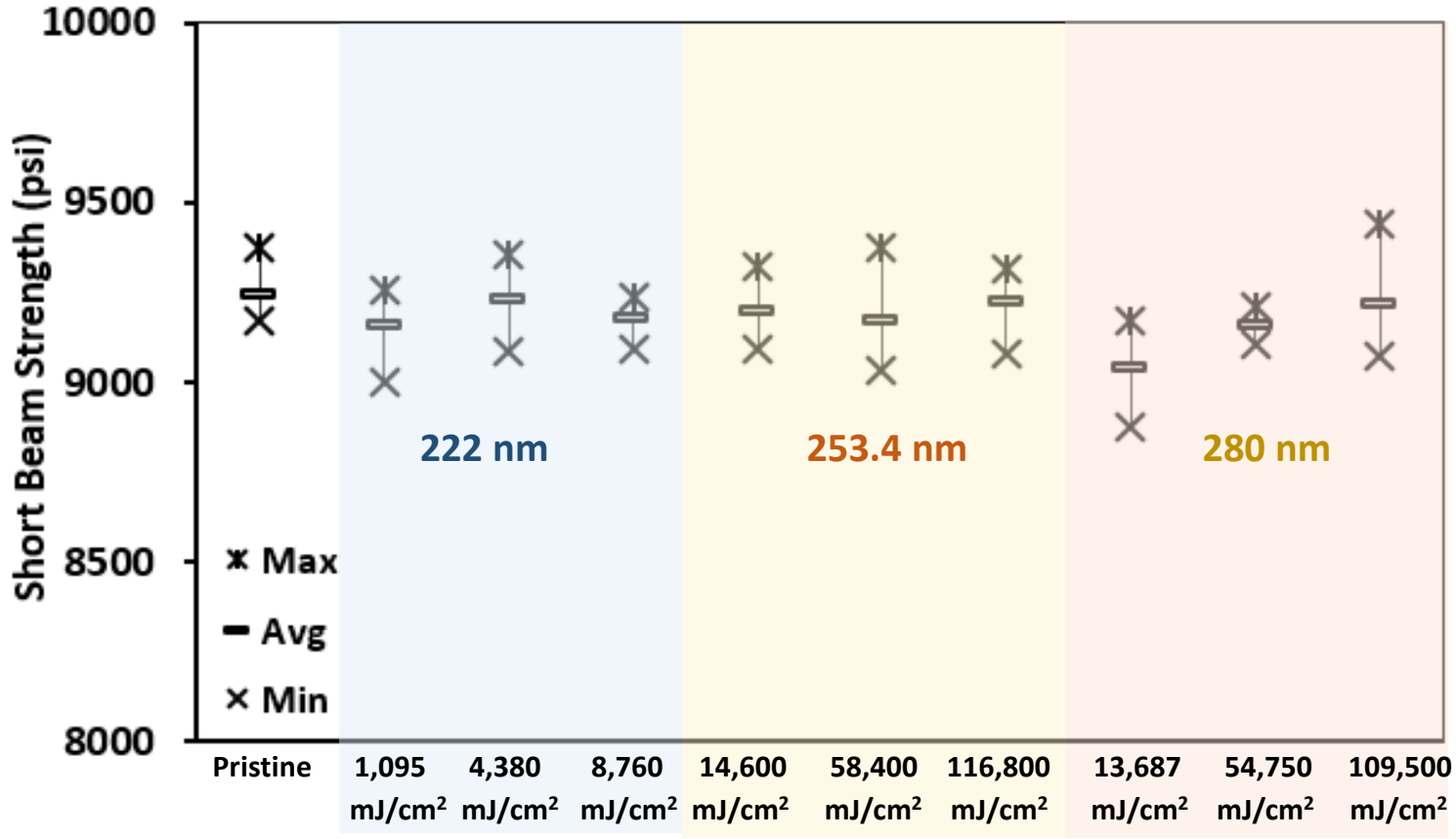


280 nm; 109,500 mJ/cm²



Fiberglass Laminate: Test Data Comparison

Results & Discussion



Summary & Conclusions

Effects of Ultraviolet-C Irradiation on Aircraft Cabin Interiors

Summary

Effects of Ultraviolet-C Irradiation on Aircraft Cabin Interiors

Aircraft Cabin & Seating Interiors

Plastics –

- Kydex 6565
- Boltaron 9815E
- Lexan XHR
- Boltaron 9815N
- Ultem 9075
- Ultem 9085

Honeycomb –

- Nomex core with fiberglass/phenolic resin

Composite –

- Fiberglass (G-10/FR4)

Accelerated UV-C Disinfection

Wavelength Configurations

- 222 nm
- 253.4 nm
- 280 nm

Properties Evaluated

- Mechanical properties.
- Change in color.

Conclusions – Change in Color

Effects of Ultraviolet-C Irradiation on Aircraft Cabin Interiors

Change in Color Compared to Pristine Specimens							
Wavelength Configuration	**Dosage (mJ/cm^2)**	**Kydex 6565**	**Boltaron 9815E**	**Lexan XHR**	**Boltaron 9815N**	**Ultem 9075**	**Ultem 9085**
222 nm	**4,380**						
	8,760						
253.4 nm	**14,600**					N/A	N/A
	58,400						
	116,800						
280 nm	**54,750**						
	109,500						

Qualitative Assessment

No Color Change

Changes in Color

Conclusions – Change in Color (Cont.)

Effects of Ultraviolet-C Irradiation on Aircraft Cabin Interiors

Change in Color Compared to Pristine Specimens			
Wavelength Configuration	**Dosage (mJ/cm^2)**	**Honeycomb** [Nomex core with Fiberglass/Phenolic]	**Fiberglass G-10/FR4 (FG1)**
222 nm	1,095		
	4,380		
	8,760		
253.4 nm	14,600		
	58,400		
	116,800		
280 nm	13,687.5		
	54,750		
	109,500		

Qualitative Assessment

No Color Change

Changes in Color

Conclusions – Yield Stress (Plastics)

Effects of Ultraviolet-C Irradiation on Aircraft Cabin Interiors

Percentage Difference Compared to Pristine Specimens – Yield Stress (Avg.)							
Wavelength Configuration	**Dosage (mJ/cm^2)**	**Kydex 6565**	**Boltaron 9815E**	**Lexan XHR**	**Boltaron 9815N**	**Ultem 9075**	**Ultem 9085**
Avg. Pristine (psi)	**N/A**	7548.1	5521.3	10328.4	6636.3	11776.0	10496.1
222 nm	**4,380**	-4.12	2.16	-4.24	-8.39	4.59	3.69
	8,760	-10.39	1.88	1.25	-9.61	3.87	3.62
253.4 nm	**14,600**	-2.61	2.45	2.10	-3.97	N/A	N/A
	58,400	-5.53	4.06	0.80	3.46	4.65	3.29
	116,800	-5.04	5.54	1.52	-2.15	4.27	6.01
280 nm	**54,750**	-3.90	2.63	1.72	-1.71	4.12	4.39
	109,500	-4.51	3.26	-1.09	-1.90	4.05	4.37

Percentage Difference Compared to Pristine Specimens

< 5%

between 5-10%

> 10%

Conclusions – Tensile Strength (Plastics)

Effects of Ultraviolet-C Irradiation on Aircraft Cabin Interiors

Percentage Difference Compared to Pristine Specimens – Tensile Strength (Avg.)							
Wavelength Configuration	**Dosage (mJ/cm^2)**	**Kydex 6565**	**Boltaron 9815E**	**Lexan XHR**	**Boltaron 9815N**	**Ultem 9075**	**Ultem 9085**
Avg. Pristine (psi)	**N/A**	6680.5	5180.4	10147.8	5263.5	9722.5	8748.4
222 nm	**4,380**	-16.49	-9.25	-10.47	-9.66	9.27	4.59
	8,760	-16.55	-6.24	0.04	-12.33	12.22	9.79
253.4 nm	**14,600**	-4.36	-3.14	-3.72	-2.49	N/A	N/A
	58,400	-13.28	-6.79	0.70	-2.07	-1.65	5.42
	116,800	-19.20	-6.67	-2.18	-7.16	11.11	8.74
280 nm	**54,750**	-9.12	0.26	-5.21	-6.42	7.78	4.26
	109,500	-9.40	-0.37	-7.09	-6.18	12.89	8.62

Percentage Difference Compared to Pristine Specimens

- < 5%
- between 5-10%
- > 10%

Conclusions – Honeycomb & Composite

Effects of Ultraviolet-C Irradiation on Aircraft Cabin Interiors

Percentage Difference Compared to Pristine Specimens			
Wavelength Configuration	**Dosage (mJ/cm^2)**	**Honeycomb – Maximum Load**	**Fiberglass – Short Beam Strength**
Avg. Pristine (psi)	**N/A**	152.4	9250.1
222 nm	**1,095**	-2.45	-0.91
	4,380	-2.75	-0.16
	8,760	-0.22	-0.75
253.4 nm	**14,600**	-9.66	-0.56
	58,400	-1.28	-0.80
	116,800	-0.24	-0.23
280 nm	**13,687.5**	5.52	-2.21
	54,750	-3.47	-0.91
	109,500	-0.74	-0.26

Percentage Difference Compared to Pristine Specimens

- < 5%
- between 5-10%
- > 10%

Possible Explanations & Notes to Consider

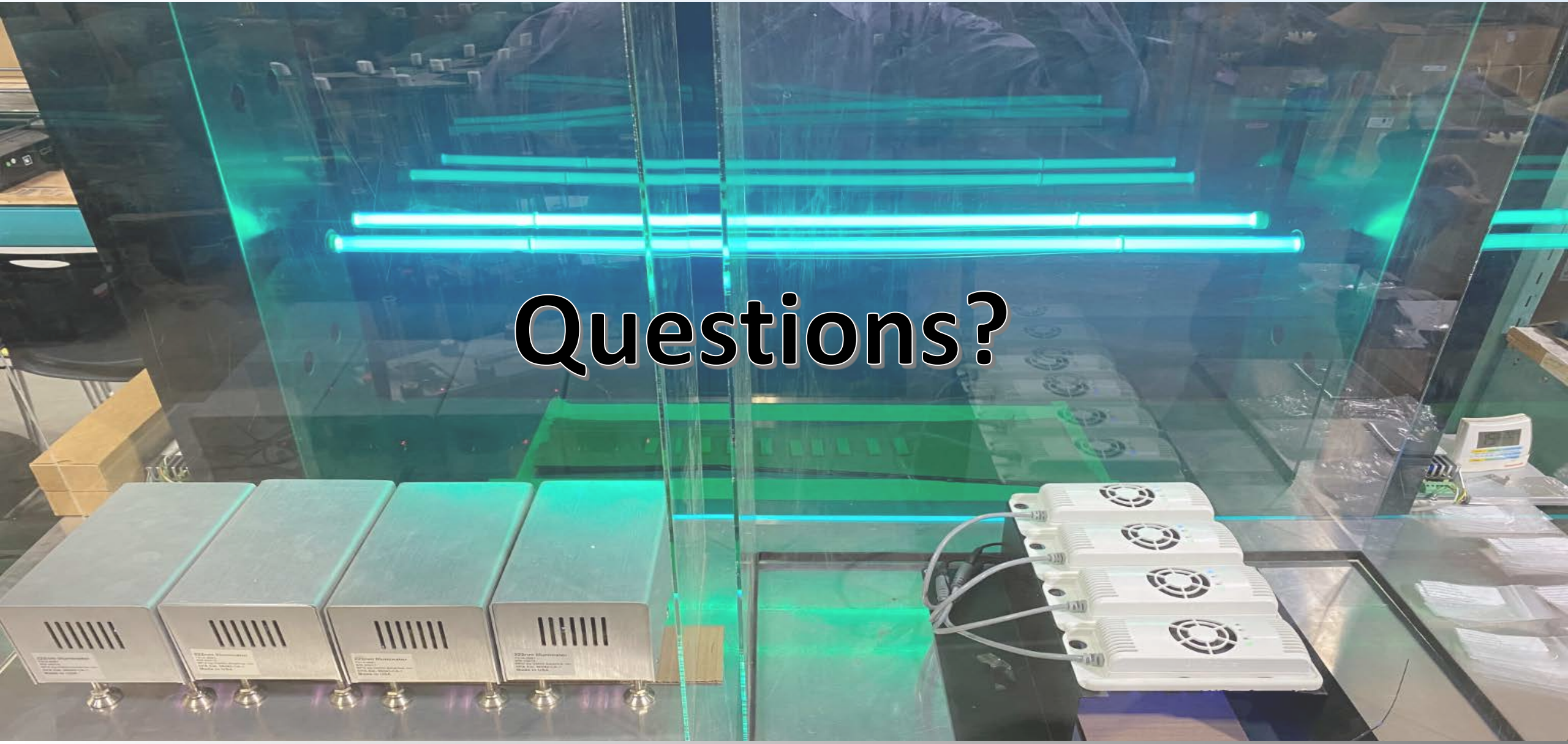
Effects of Ultraviolet-C Irradiation on Aircraft Cabin Interiors

- Critical parameters within the three wavelength configurations –
  - Irradiance.
  - Distance between the light source and the specimens.
  - Exposure duration.
  - Heat from the UV-C lamps.
- UV-C induced material degradation – photon excitation energy.
- International Ultraviolet Association (IUVA) Task Force: detailed research studies with a similar statement of work.

Ongoing & Future Work

Effects of Ultraviolet-C Irradiation on Aircraft Cabin Interiors

- Other materials currently being evaluated from aircraft cabin and flight deck are:
  - Lexan 9600
  - Poly II Acrylic.
- Report under review and to be published by FAA.



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