Additive Manufacturing Systems For High Performance Polymers

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additive manufacturing GmbH

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Orion AM Systems

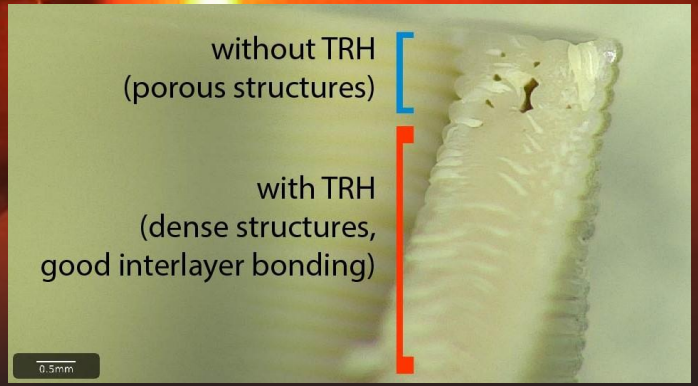
A460 Industrial Large-Format
- D460 x H500 build volume
- 315°C heated chamber
- Integrated filament dryer

M150 Medical Desktop
- D180 x H150 build volume
- 315°C heated chamber
- Designed for medical environments

A150 Industrial Desktop
- D180 x H150 build volume
- 315°C heated chamber

Thermal Radiation Heating (TRH)

Injection Molding
Strength & Density



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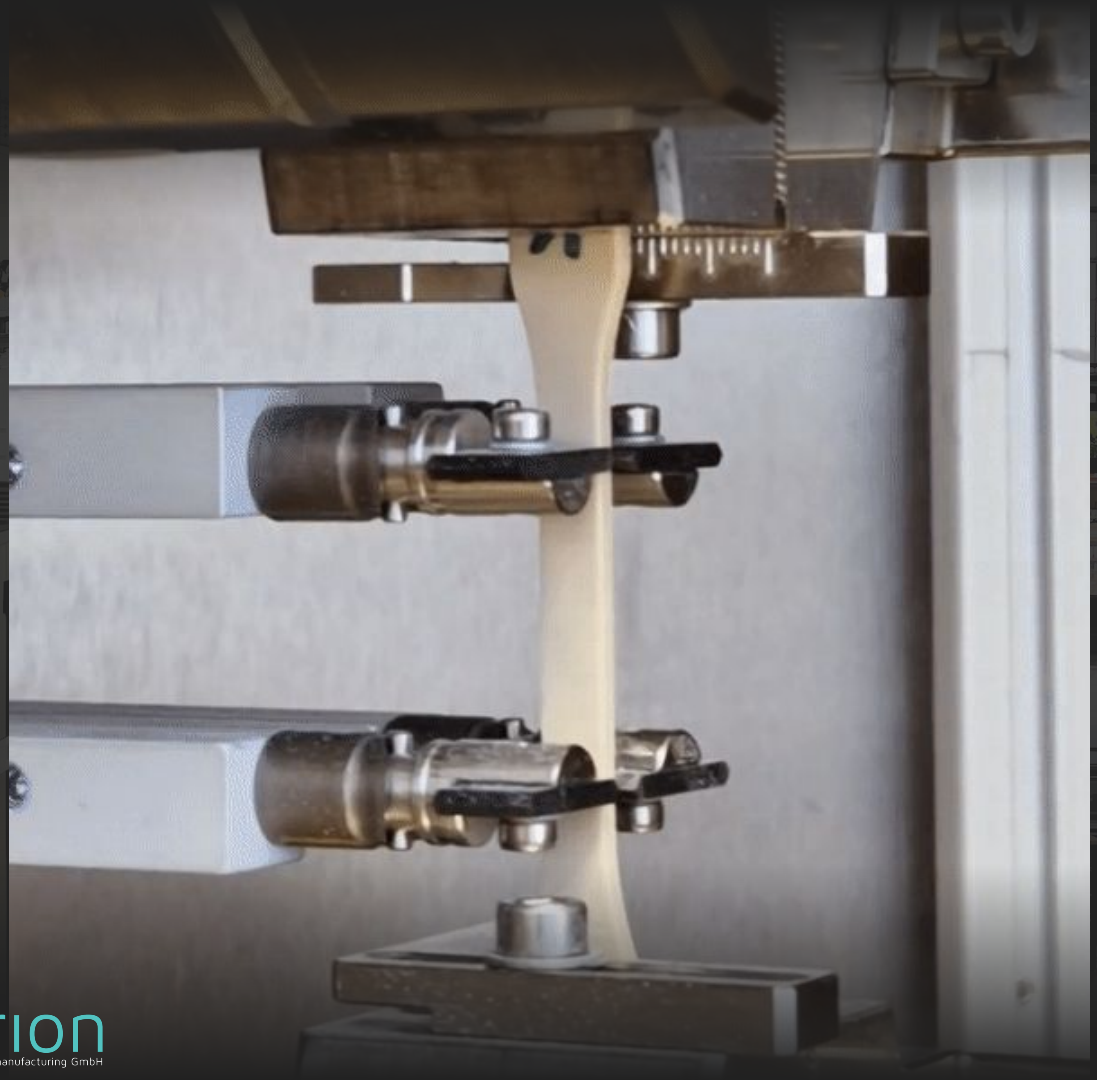

Stronger than Injection Molding

PEEK Specimen
Z-orientation
No delamination
97.2 MPa
Tensile Strength

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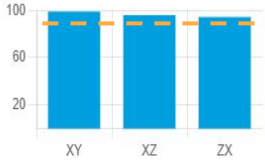
Injection Molding Strength & Density

Industrial Grade PEEK Filaments

SYENSQO

KetaSpire® PEEK

Tensile Strength (MPa)



Injection Molding Strength: 91 MPa

EVONIK
Leading Beyond Chemistry

INFINAM® 9359F

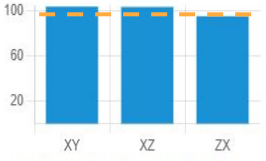
Tensile Strength (MPa)

Injection Molding Strength: 90 MPa

victrex

Victrex AM™450FIL

Tensile Strength (MPa)



Injection Molding Strength: 98 MPa

Lehmann&Voss&Co.
LEHVOSS Group

LUVOCOM® 3F PEEK 9581

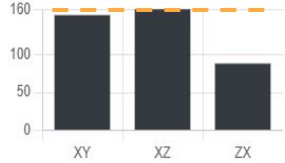
Tensile Strength (MPa)

Injection Molding Strength: 95 MPa

SYENSQO

KetaSpire® PEEK CF

Tensile Strength (MPa)



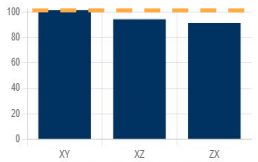
Injection Molding Strength: 159 MPa

Medical/Implantable Grade PEEK Filaments

Invibio
BIOMATERIAL SOLUTIONS

Invibio PEEK-OPTIMA® LT1

Tensile Strength (MPa)



Injection Molding Strength: 100 MPa

EVONIK
Leading Beyond Chemistry

VESTAKEEP® PEEK i4 3DF

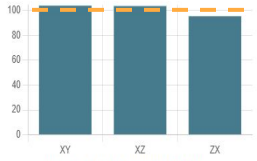
Tensile Strength (MPa)

Injection Molding Strength: 94 MPa

Ensinger

TECAFIL PEEK VX MT

Tensile Strength (MPa)



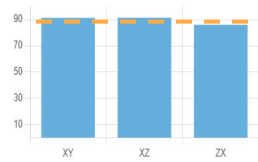
Injection Molding Strength: 100 MPa

Other High-Performance Polymers

victrex

Victrex AM™200FIL

Tensile Strength (MPa)

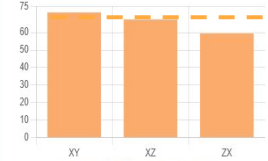


Injection Molding Strength: 90 MPa

SYENSQO

Syensqo Radel® PPSU

Tensile Strength (MPa)

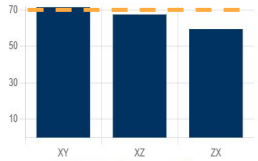


Injection Molding Strength: 74 MPa

sabic

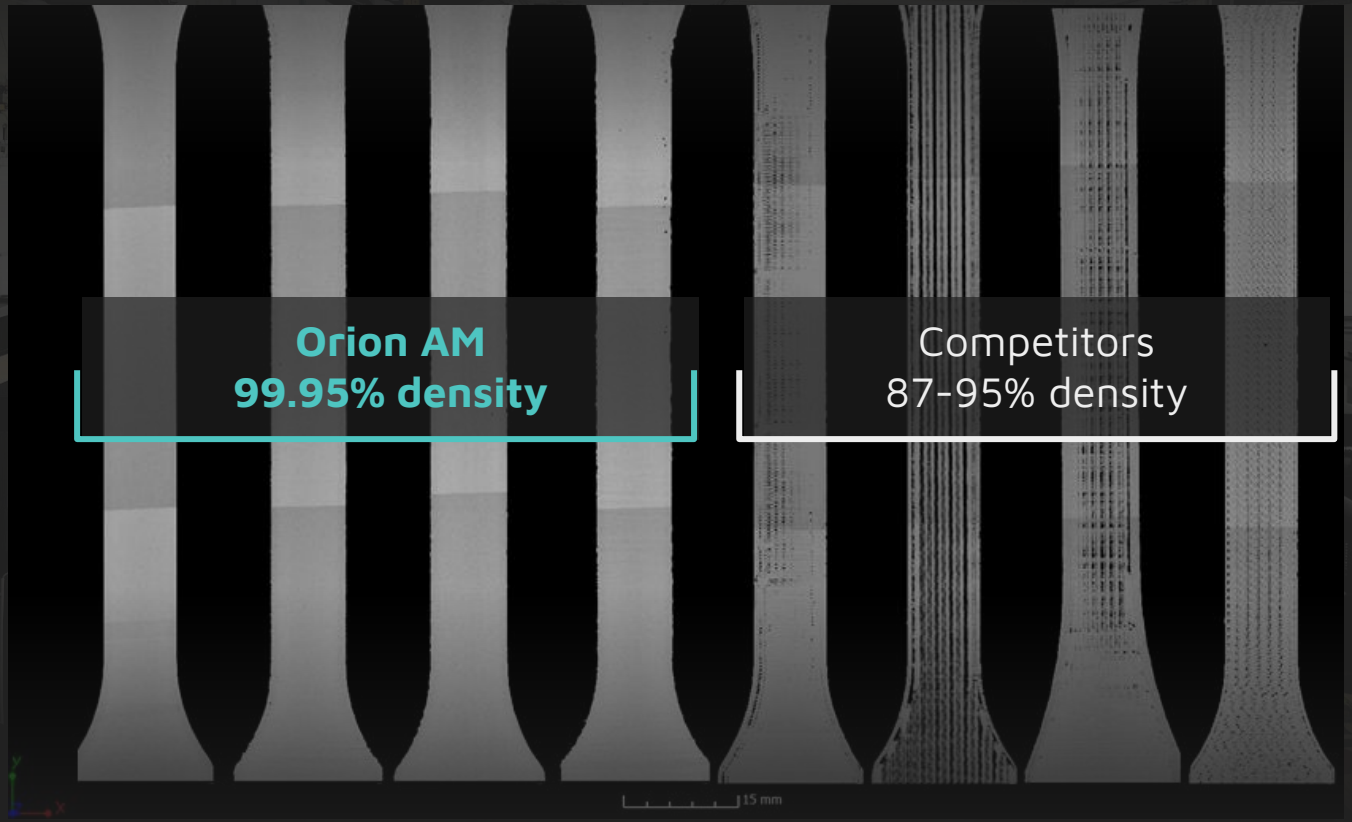
ULTEM® 9085

Tensile Strength (MPa)



Injection Molding Strength: 70 MPa

Injection Molding Strength & Density



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Pressure & Porosity Testing

Credit: ADD-ASTRA LIMITLESS MATERIA INNOVATION

3D Printed PEEK
Up to 2.5 bar pressure

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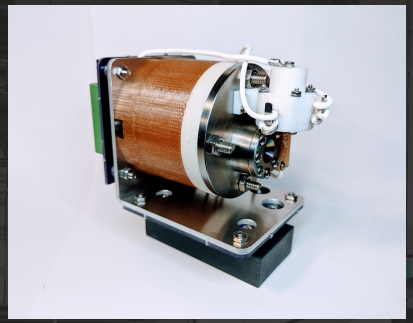
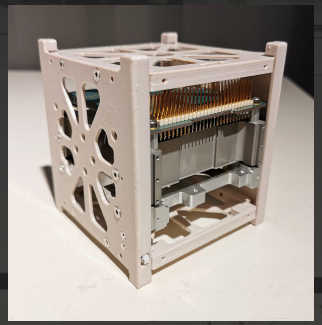
Strong Enough For Space

- Mass Customization
- Fewer Parts
- Faster Production
- Lightweight Metal Replacement
- High Temperature Resistance
- Up to 50% mass reduction
- Low Outgassing
- Demissible Structures

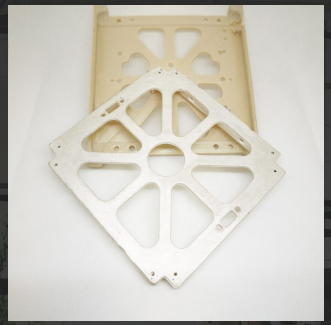
Space Applications



Cubesat Ion Thruster System
Material: ULTEM1010 (PEI)
Image Credit: AIS

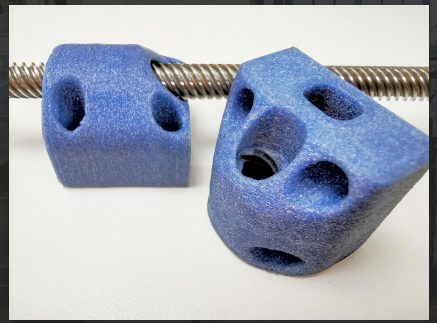


PEEK Cubesat Frame
Material: Syensqo Ketaspire PEEK
Image: Orion AM

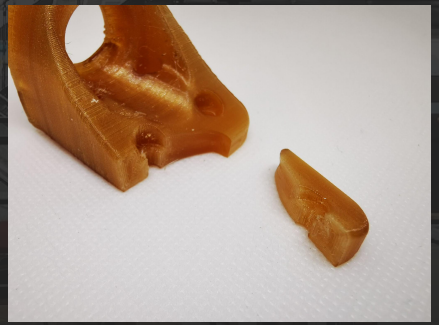


Metalized PEEK Cubesat Frame
Material: Victrex AM450FIL
Image: Orion AM

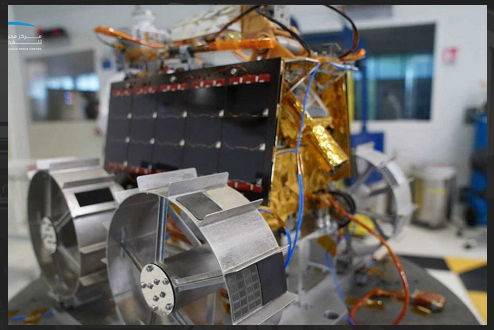
CF PEEK Cubesat Battery Pack
Material: Ensinger TECAFIL PEEK VX CF30
Image: Orion AM



Automation Components
Material: igus A350
Image: Orion AM



Bracket
Material: ULTEM1010 (PEI)
Image: Orion AM



3D-Printed Parts on Rashid Rover Wheels
Material: PEEK + CNT + Graphene
Image: ESA

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Safe Enough For Implants

- Injection Molded Strength
- Biocompatible PEEK or PPSU
- Patient-Specific Implants
- Surgical Guides/Instruments
- Trial Spacers
- Mass Customization
- Integration at POC
- Reduced Lead-Time

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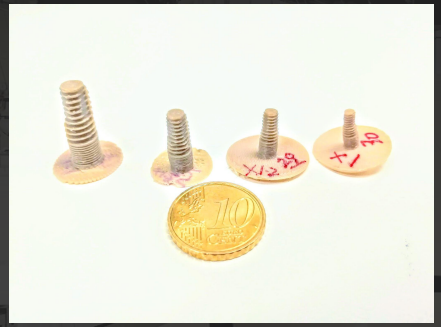
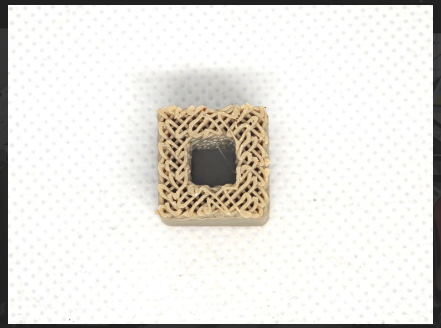
Applications in Medical



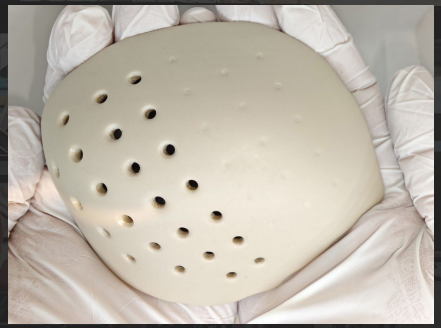
Dental Implants - Charité
Material: Evonik VESTAKEEP
Image: Orion AM

Heart Plug - Universitätsklinikum Tübingen
Material: Evonik VESTAKEEP
Image: Orion AM

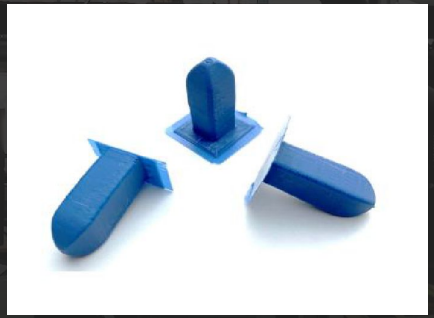
Lumbar Cage
Material: Evonik VESTAKEEP
Image: Orion AM



Spinal Implant
Material: Invibio PEEK Optima
Image: Orion AM



CMF Implant
Material: Invibio PEEK Optima
Image: Orion AM



PPSU Trial Spacers
Material: TECAFIL PPSU MT XRO blue
Image: Orion AM

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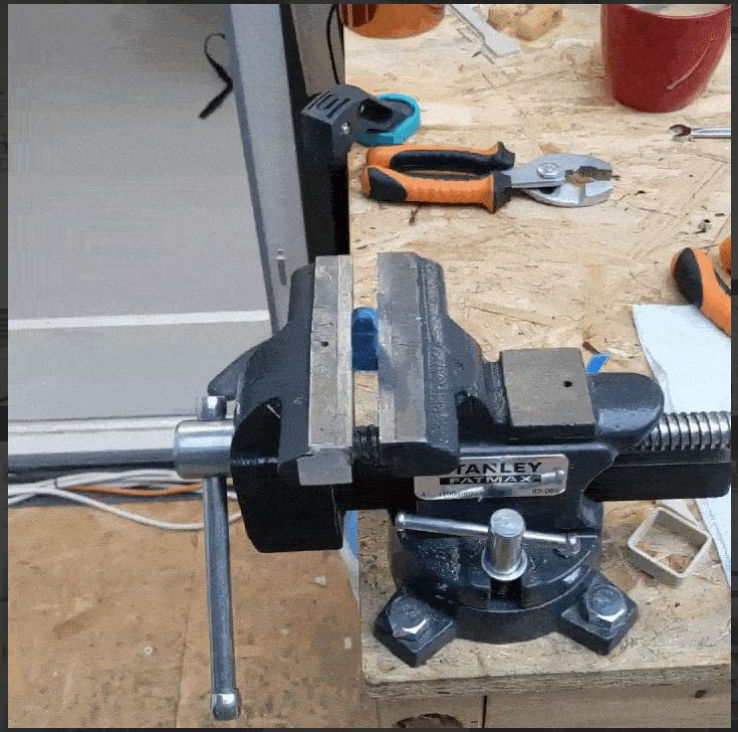
PPSU Validation



Ensinger TECAFIL PPSU

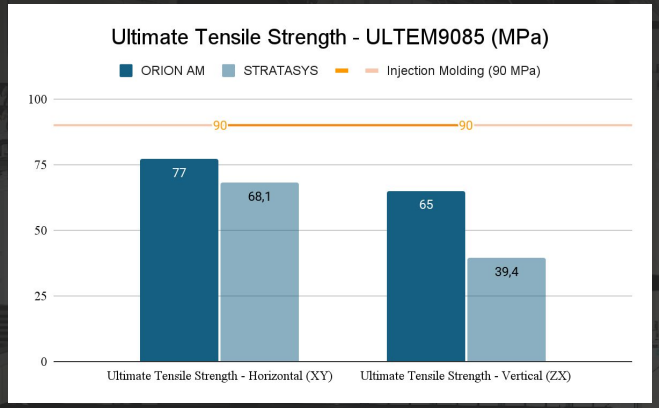
- Tensile Strength: ~70 MPa
- Heat Deflection: 207°C
- High Impact Strength

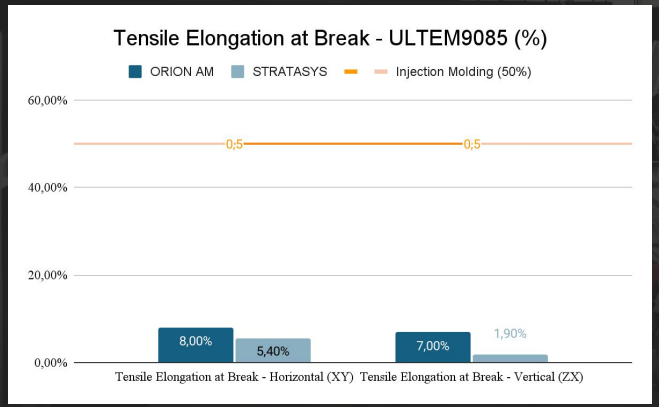
Industrial Applications

LUVOCOM®-3F-PEI-50236-GY
Image: 3D4MAKERS

- High temperature resistance
- Excellent chemical resistance
- High dimensionally stable precision
- Outstanding fire resistance (UL V0 and EN 45545 -2 R1 HL3)
- Compliant with EN45545

ULTEM™ 9085 Validation





- Unlocking ULTEM™ 9085: Orion's TRH outperforms current FFF systems in both strength and ductility.
- **65% increase in vertical tensile strength** (65 MPa vs. conventional 39.4 MPa)
- **268% increase in vertical elongation** at break (7% vs. conventional 1.9%).
- Eliminates the Z-axis weak point, allowing engineers to design structural, load-bearing aerospace parts for build efficiency rather than orientation constraints.

Credit: AMPOWER

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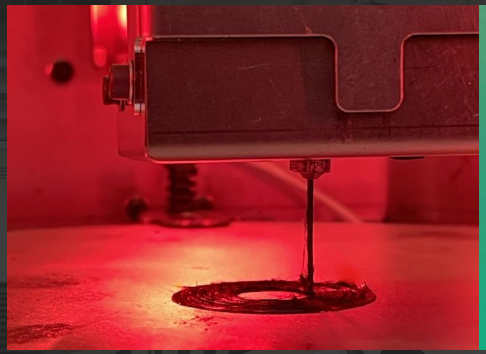
Continuous Carbon Fiber + PEEK



Suprem Filaprem CF/PEEK	TRH-ON	TRH-OFF	Markforged Carbon
Tensile Strength (MPa)	1261	850	800
Tensile Modulus (GPa)	120[1][2]	120[1][2]	60
Elongation at break (%)	-[2]	-[2]	1.5
Flexural Strength (MPa)	621	501	540
Flexural Modulus (GPa)	**113**	96.5	51
Elongation at break (%)	0.6	0.6	0.7

(1) Filaprem CF/PEEK is expected to be between 80-120 GPa

(2) Due to errors in measurement the tensile modulus and elongation data were omitted

Large-scale Continuous Composite 3D Printing

- Fused Filament Fabrication remains most suitable for composites and large scale applications in space
- Few polymers can be used in space, PEEK is one of them
- PEEK + Continuous fiber is a new composite stronger than metal
- Achieved a **tensile strength of 1260MPa** and **flexural strength of 621MPa** using Orion AM's thermal radiation system (higher than Markforged CFF tensile strength of 800MPa and flexural strength of 540MPa)

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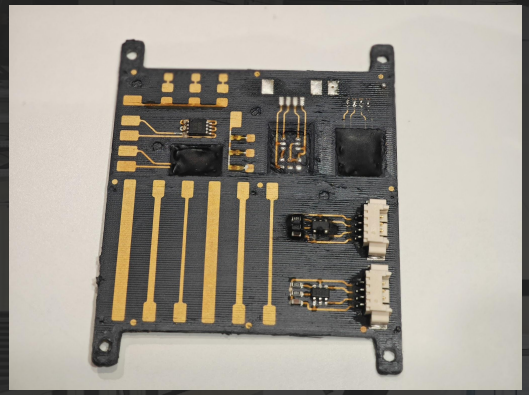
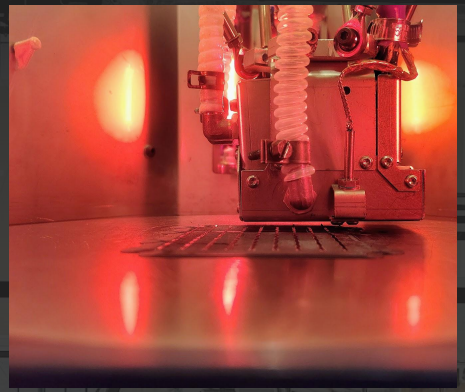
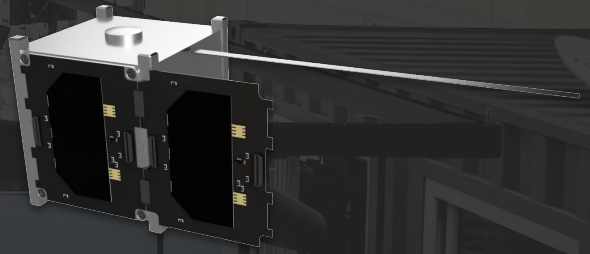
AM-SPACE Project

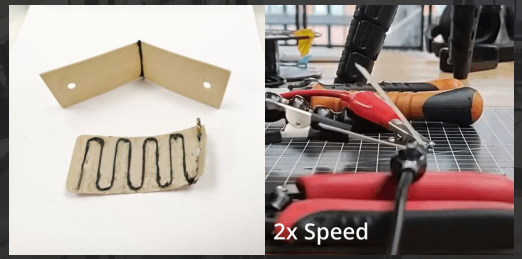


Embedded Printed Circuits
Material: TECAFIL PEEK LDS

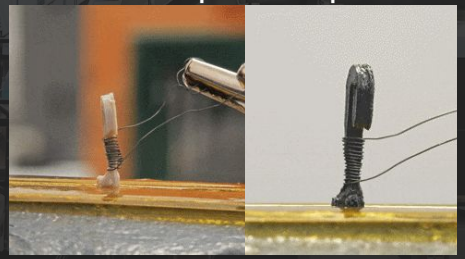


Continuous Carbon Fiber + PEEK
Material: Suprem Filaprem





Shape Memory Hinges
Material: Syensqo Ketaspire PEEK



Shape Memory HDRM
Material: Syensqo Ketaspire
PEEK + PEEK CF10

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