Martin Materials Solutions Technology Developments

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Martin Materials Solutions LLC

SPACE POWER WORKSHOP, APRIL 21-23, 2026

Martin Materials Solutions LLC

- An upstart coverglass supplier celebrating its tenth year in business!
- Growing business now collocated with strategic coating partner Visimax Technologies in Twinsburg, Ohio
- Our Mission: Strengthen the U.S. space industrial base by promoting domestic manufacturing through innovation, integrity & technology.

Working together, we re-established U.S. spaceglass manufacturing to the space solar power market

Spaceglass™ Materials

- Materials-agnostic philosophy
- Large stock of heritage Corning 0214 glass
- Glass solutions for diverse orbits:
  - Thin 0214 replacement for future LEO/GEO/Lunar requirements
  - Thick glass for high radiation MEO missions

Thickness	Equivalent MW
100µm	1.6
150µm	2.7

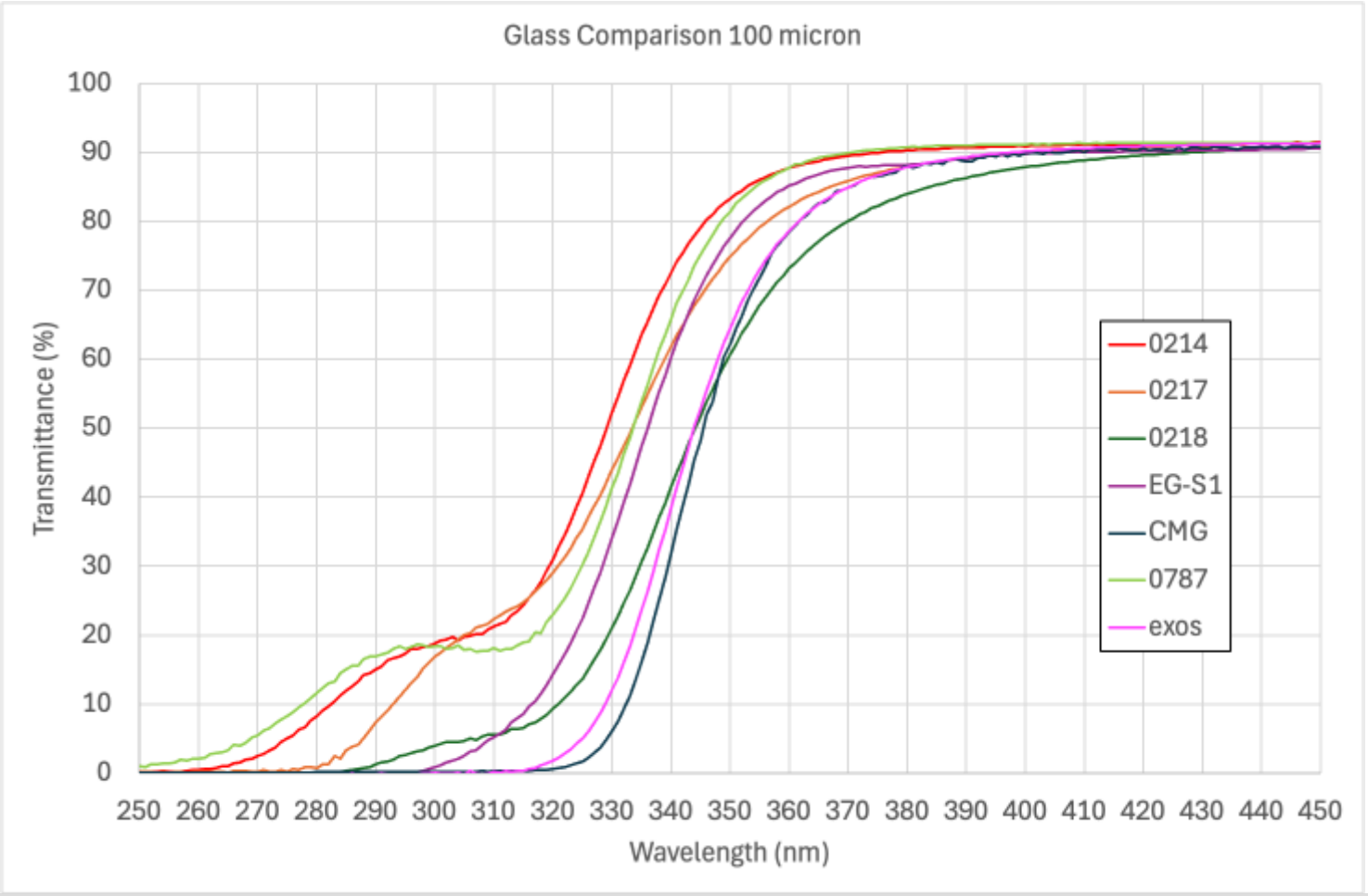
0214 Replacement Initiative

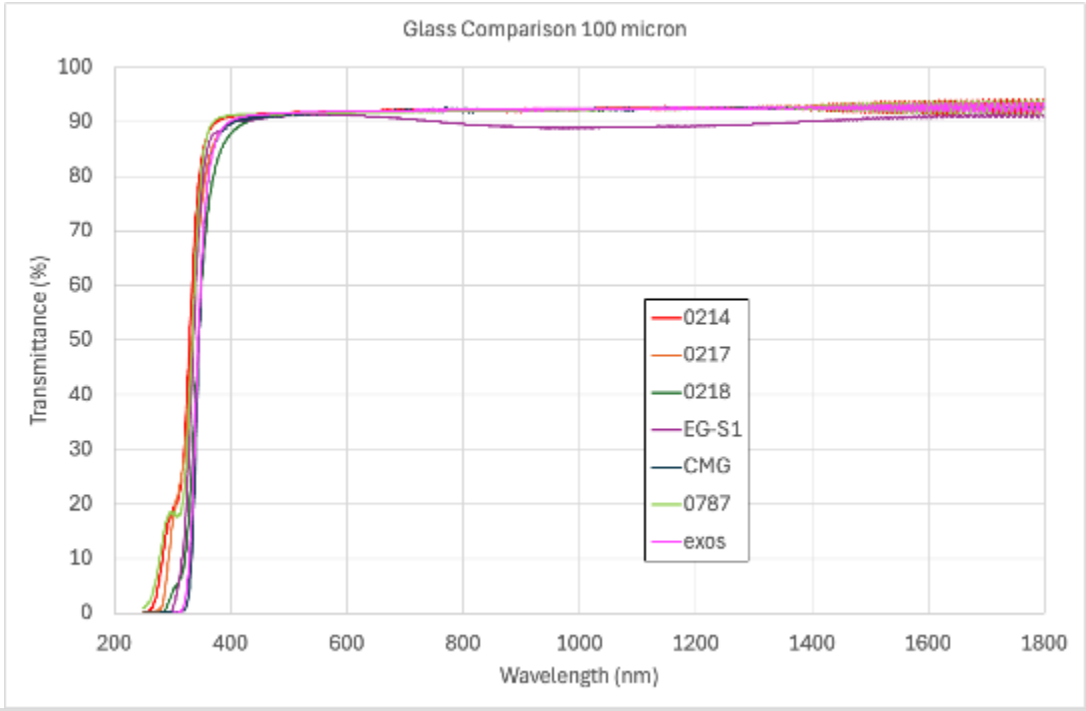
- MMS processing inventory 0214 (100µm and 150µm only)
  - New 0214 material is unavailable → a replacement is needed
- Many glass compositions to evaluate
  - Internal material research + coordination with Aerospace Corporation
  - *Non-radiation resistant glass not under consideration*
- Key players for `spaceglass`™:
  - Schott (Heritage 0787, Solar Glass exos)
  - Corning (Heritage 0213/0214, UTG 0217, 0218)
  - AGC (EG-S1, EG-S2)

0214 Replacement Factors

Radiation Stability	Optical Performance	Strength	Flatness
TTV	Thickness Range	Availability	Cost

Transmission Performance



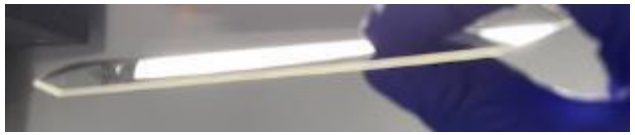


Thick Coverglass: MMS AB-1

AB = Alternative to Borosilicate microsheet

Thick coverglass for high radiation missions
Alternative to microsheet & Fused Silica
Machined, not slot-drawn
Wide thickness range (400µm to >1mm)
Extensive radiation testing performed
Next step is full ECSS qualification and flight
Customer evaluation & testing underway
Baseline solution on many MEO proposals

- Benefits over Fused Silica
  - Better CTE (8.0 vs. 0.5)
  - UV Absorption
  - Lower cost
- Benefits over Borosilicate Microsheet
  - Radiation performance
  - Flatness
  - TTV
  - Thickness ranges



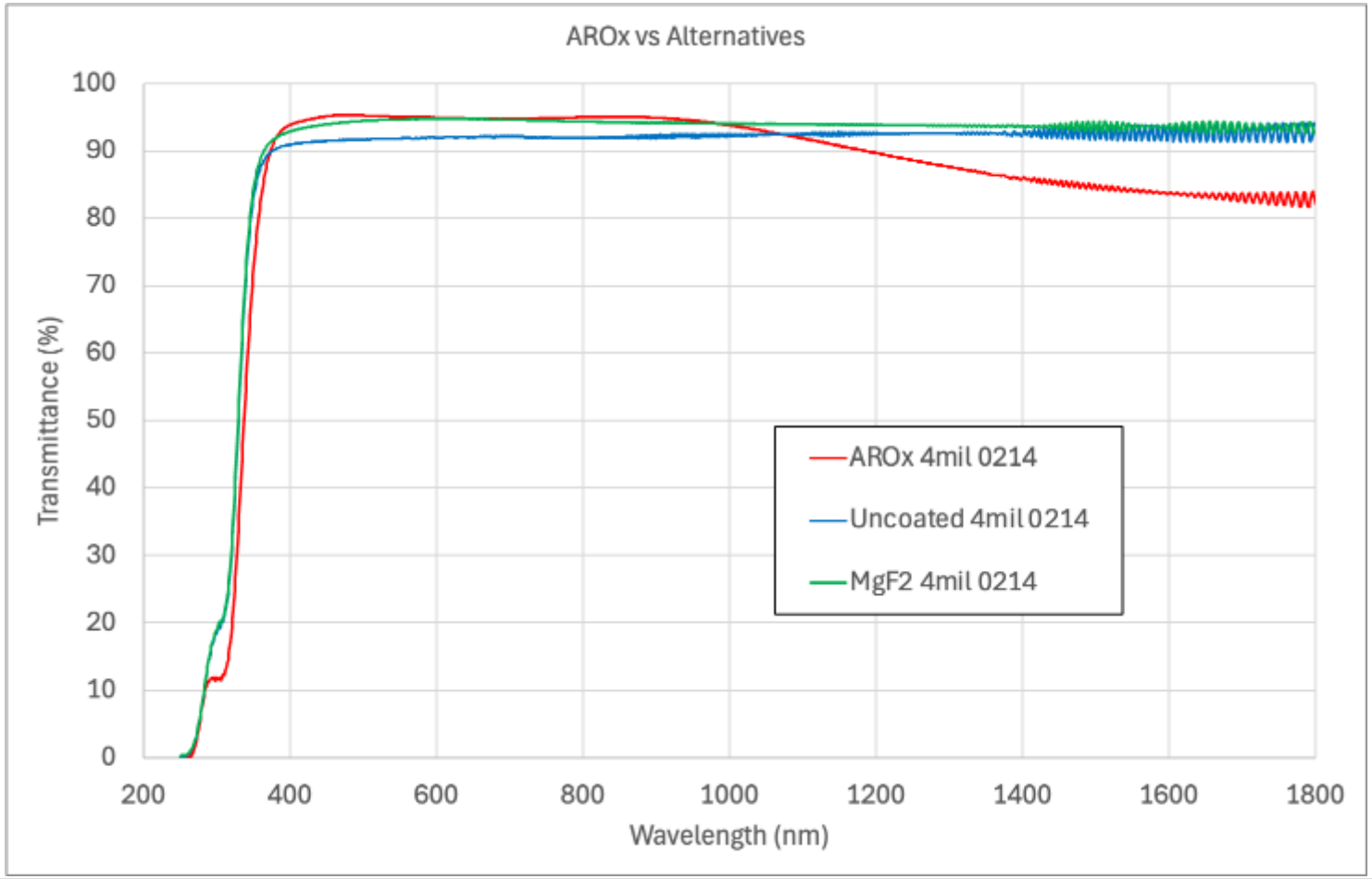
AB-1 Test Regime

- Radiation Testing – excellent results!
  - 8e14, 3.0MeV proton irradiation
  - 1.0e15, 1MeV electron irradiation
  - 2000ESH UV exposure
  - Multi-Fluence, Multi-Energy Proton Testing (1, 2, 3, 4, 5, 7, 10, & 20Mev)
  - Reports & Specs available upon request
    - MMS-MAT-002 Rev D Characterization of Radiation Shielding Glass AB-1
    - MMS-CG-100A Rev - AR-coated Product Spec
    - MMS-CG-000A Rev - Uncoated Product Spec
- Environmental & Mechanical testing planned for 2Q26-3Q26

AROx Coating for Atomic Oxygen

- Increasing number of LEO/VLEO missions in high ATOX environments
- MgF_2 coatings do not perform well → customers who opt to use uncoated glass face BOL performance penalty
- Requirement for AR coating that can withstand high ATOX
- Solution: Multi-layer oxide-based coating that can be tailored to maximize performance
  - e.g. top and middle TJ sub-cells
- Designed to be cost competitive to MgF_2 AR

AROx Coating for Atomic Oxygen



- Proprietary coating with ZrO_2/SiO_2 materials
- High %T in the wavelength range relevant to top/middle cells of 3J
- Reduction in IR %T to bottom cell reduces thermal efficiency losses

AROx Testing Performed & Planned

- Initial testing: electron, humidity, and ATOX
  - ATOX testing was inconclusive – possible contamination
  - Retest to be scheduled + alternative Plasma Asher testing planned
- Sampling program underway at numerous customers
- ECSS qualification testing planned for 3Q2026
- MMS-CG-600 Rev - AROx Product Spec (Preliminary)
  - *Available upon request*

Thermal Control Mirrors

- Thermal control mirrors (TCMs) used for spacecraft radiators (and potentially other surfaces)
- TCM performance is based on low α and high ε
- Much more robust than polymer-based tape and paint
- Heritage product uses silver as the reflective material, but MMS can be more flexible (i.e. Aluminum)
- 0214 Glass low absorbance reduces the need for complex front-surface coatings (high performance at lower cost)

TCM Performance & Testing

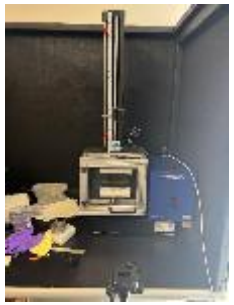
- Development challenges included pinholes and edge delamination
  - Solved with process optimization and introduction of laser-scribed edges
- Solar absorptance is approximately 0.07 without UV reflector coating
- Thermal emittance is approximately 0.88
- Solubility passed
- Humidity passed
- Adhesion (tape) passed
- UV, Proton, & electron testing 3Q26 – 4Q26

Manufacturing at MMS

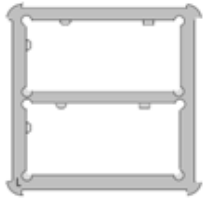
- Increase vertical integration of processing steps
- Streamlined processes = lower cost and lead time
- Investments in state-of-the-art processing and metrology equipment

CLT45G Laser

Nikon VMM



Admet Load Cell

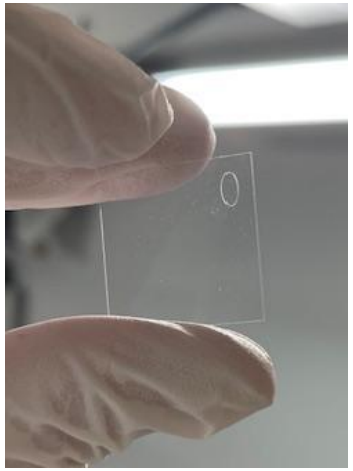


Smart Tooling

Manufacturing at MMS

Glass Material Inventory → Sizing: MMS → Cleaning: Visimax → Coating: Visimax → QA & Shipping: MMS

Co-located with thin film coating supplier Visimax



Corning CLT45 laser scribe system

Steps removed: scribing, flattening, blocking, CNC machining, de-blocking, de-waxing

ELMA ultrasonic cleaning system at Visimax. Second system to be procured for capacity and removing single point failure

Smart coating tooling and laser marking to provide coated face ID.

Removes organic solvent inks from the product

Digital data packs & innovative packaging allows MMS to support customers' automated processes

Growth

- The first 10 years: Organic growth through reinvestment & customer retention
- Recognized as a strategic supplier to the U.S. space and defense industrial base
- 3-year DPA Title III proposal submitted
  - Increase manufacturing capacity & capability
  - Facilitate acquisition and qualification of 0214 replacement glass
  - Grow in-house metrology capabilities

Conclusion

- MMS is here to stay
- Continue to build onshore spaceglass™ capability & capacity
- Widely accepted as a qualified supplier and/or preferred source
- Sustained success through close collaboration with partners across the space industry to identify optimal solutions that meet space qualification requirements.