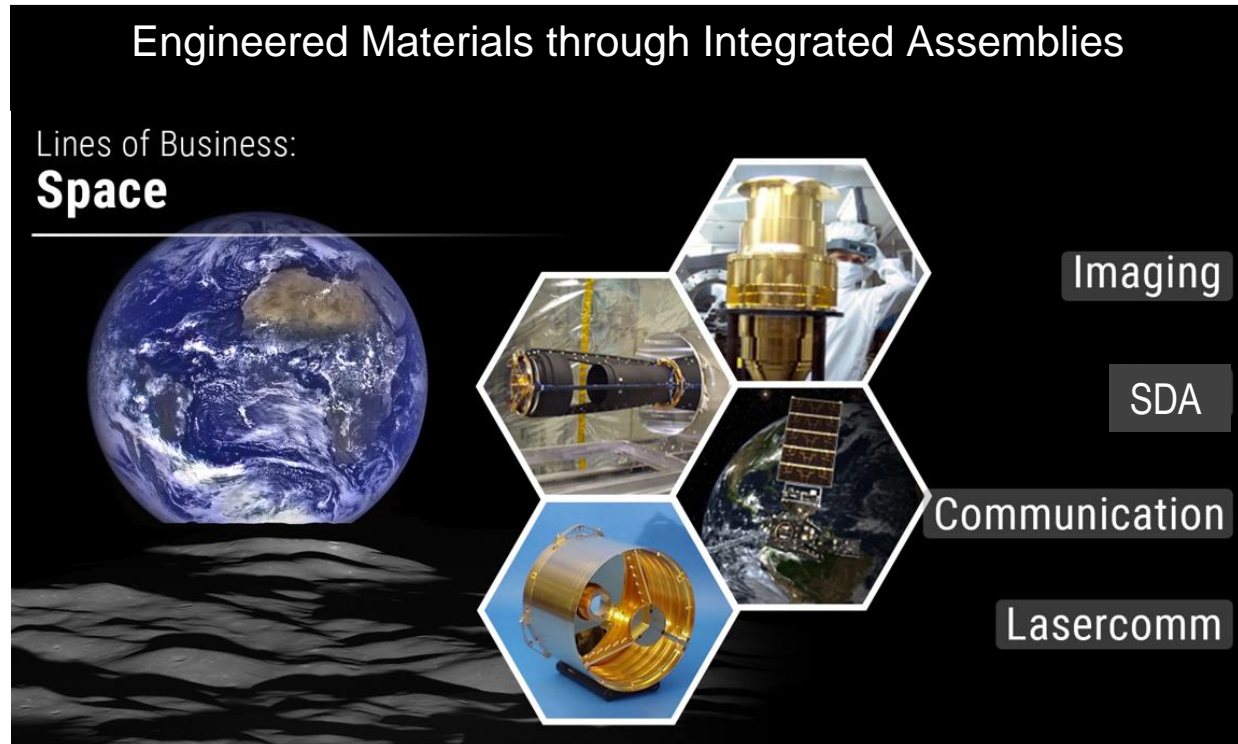


II-VI Aerospace & Defense

Capabilities Statement for IARPA SINTRA

Engineered Materials through Integrated Assemblies

Lines of Business:
Space



Imaging

SDA

Communication

Lasercomm

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1 Capabilities Summary

II-VI Aerospace & Defense (II-VI A&D) works with customers to design, fabricate, integrate and test spaced based optical systems including Telescopes and Telescopes Integrated with Cameras.

II-VI A&D has the design and analysis tools, prototyping, manufacturing, test facilities, and qualified personnel that are required to support the design, development, fabrication, production and delivery of space flight optical assemblies including sensor assemblies. Our technical, management, and quality assurance teams have over 20 years of experience in the development and production of complex space-qualified optics for a wide range of applications, including, planetary exploration, lunar exploration, earth observation, laser communications and missile defense.

II-VI has over 20 years of experience in the development and production of complex space-qualified optics. We are interested in supporting the Prime System Integration for SINTRA using our hardware design and manufacturing expertise.

We have an established space flight heritage in our Tustin CA facility and high-performance refractive lens fabrication and coating capabilities in our Murrieta CA facility. Both facilities have optical assembly clean rooms and are cleared to DoD collateral Secret storage. Secure design, test and manufacturing can be performed at our Tustin facility. These combined capabilities provide customers with expertise not available elsewhere. Recently, II-VI acquired Coherent Inc., which adds the Optical Fabrication and Coating Capabilities of Tinsley to II-VI A&D. These new capabilities can be used to address the SINTRA Space Debris using our Space Telescopes or now Large Optics for Ground Telescopes

II-VI A&D works with customers, typically the Primes, from requirements development through production of the full optical sensor. We have the capabilities to assess requirements and develop the design, fabrication, manufacture, integration and testing for full optical sensor assemblies. We typically work in a collaborative manner with our customers, the Primes. The IARPA suggested teaming approach, fits into our approach. We are interested in supporting the Prime System Integration using our hardware design and manufacturing expertise. This begins early in the system design and development phase so that we can support discussions on design for manufacture and production. This will reduce development risk and system cost.

2 II-VI A&D Space Capabilities

Figure 1 shows a graphical history of the space systems that we have been involved with, developed, and deployed since 1998. We have designed, manufactured, integrated, tested, and delivered optical assemblies that could be leveraged for the SINTRA program.

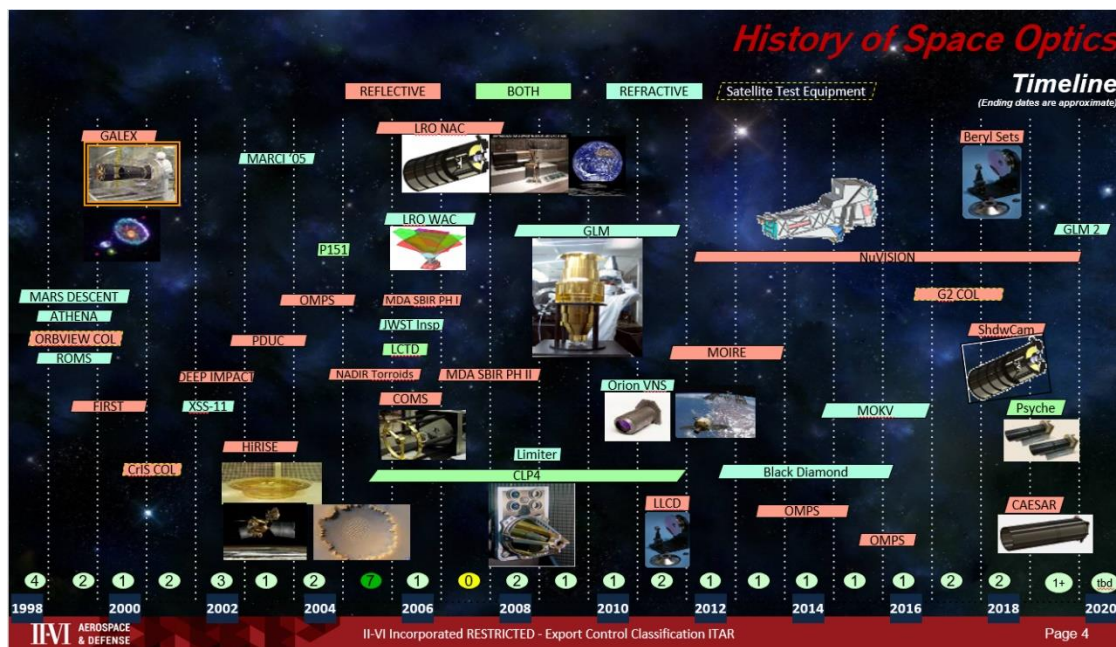


Figure 1: II-VI A&D History in Space

II-VI A&D designed, analyzed, fabricated, tested, and delivered the optics suite for the Lunar Reconnaissance Orbiter (LRO) mission. The optics consisted of two Narrow Angle Camera (NAC) Telescopes and one Wide Angle Camera (WAC) optical system. The NAC Telescopes provide evidence of our overall capabilities and experience with space qualified optics using carbon fiber materials. The WAC optical system is a complex optical assembly with a refractive optical system. The LRO NAC optics was to provide high-resolution mapping (max 0.5 meters) to assist in the selection and characterization of future landing sites. The primary technical challenges in the design and fabrication were: 1) be highly athermal and maintain focus in a high thermal gradient environment; 2) be very light; and 3) provide very high optical performance (MTF) to image small features on the surface of the moon. To meet those challenges the design utilized carbon fiber metering structures and Zerodur mirrors. Extensive testing and structural and thermal analysis were conducted during the development, and precision alignment features and methods were developed to ensure success of the program. The mission has accomplished all its goals, and Figure 2 shows an on-orbit picture of the lunar surface with photographs of the two optical systems as insets. In addition, the LRO NAC has provided some of the first images of leftover Apollo equipment on the Moon, including photographs of the astronaut’s footprints.

Our proven Lunar Reconnaissance Orbiter Narrow Angle Camera Telescope Assembly might be a good choice to support a IARPA SINTRA Space Debris Mission.

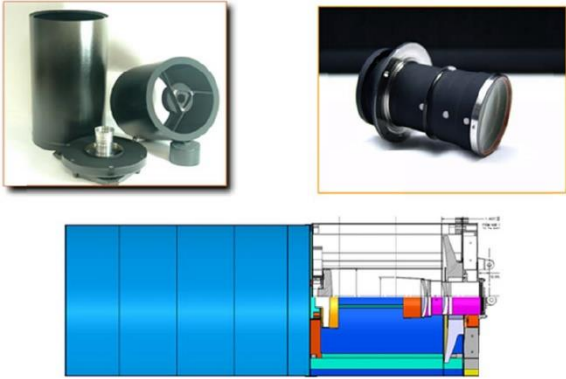
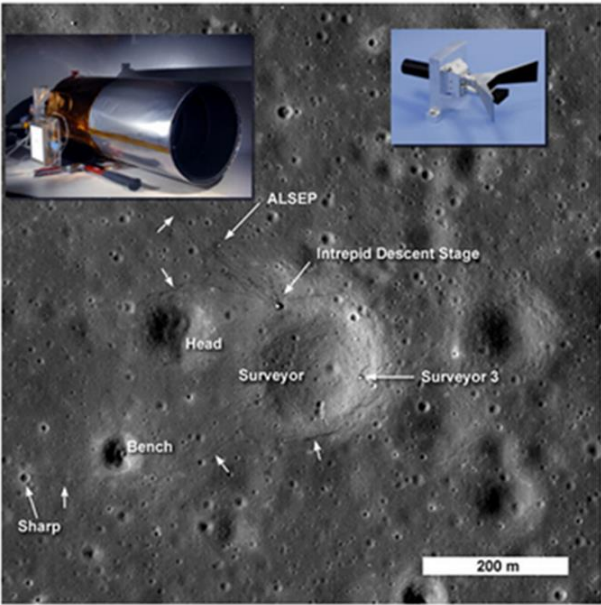


Figure 2 – Lunar Reconnaissance Orbiter, Optics (Insets) and Lunar Images (left). Narrow Angle Camera – Hardware and Concept (above).

3 About II-VI A&D

The II-VI A&D is dedicated to serving the U.S. Government through 4 strategic business areas: Space, High Energy Laser Subsystems, Intelligence Surveillance & Reconnaissance (ISR) and Missiles as depicted in Figure 4. The II-VI A&D organization has over 520 highly skilled employees who support design, manufacturing, and assembly of our products. We have a large engineering and technical staff who support the design, manufacture, and test of a wide range of products. Our customer base is typically the U.S. Government agencies and Tier 1 Aerospace Prime Contractors and Government Laboratories, which includes but is not limited to Lockheed Martin, General Atomics, Raytheon, Boeing, Ball Aerospace, Northrop Grumman, L3Harris, DRS Technologies, MIT Lincoln Laboratory, Malin Space Science Systems, and JPL. II-VI A&D is AS9100D and ISO 9001:2008 registered. II-VI A&D complies with all FAR/DFAR regulations and II-VI A&D is subject to Full CAS (Cost Accounting Standards). II-VI A&D manufactures aerospace products in each of the four lines of business exclusively in the U.S. at nine different locations.

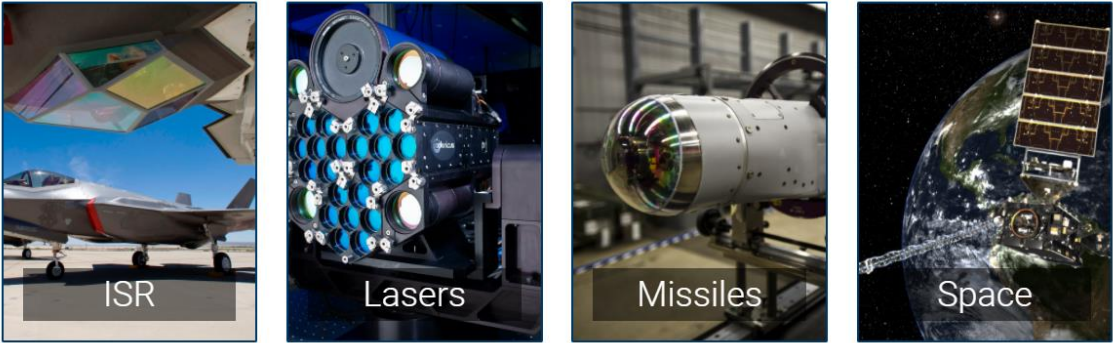


Figure 3. II-VI A&D has focused strategic business areas in systems in ISR, Lasers, Missiles and Space.

II-VI A&D is a division of II-VI Inc. and operates as a separate legal entity from II-VI Inc. to allow complete separation and compliance to all DoD and government regulations. As a subsidiary of

parent company II-VI Incorporated, we have the financial support needed to continue to grow our business, maintain key personnel, make capital investments, and conduct internal R&D activities. II-VI, Inc recently completed the acquisition of Coherent Technologies which brings the Coherent Tinsley location into II-VI A&D providing additional large space optics fabrication and coating capabilities as depicted in Figure 5.



Figure 4. With the acquisition of Coherent, II-VI A&D can also provide large optics fabrication and coating. Pictured are images of the James Web Space Telescope (JWST) mirror elements.

Our on-time delivery performance for space-based programs is excellent. Satisfying our commitments to our customers including on time delivery are primary focuses for II-VI. To assure the best possible customer experience, we staff each program with a dedicated Program Manager who provides a single point of communication between II-VI and our customers. Our products are leading edge, usually custom designed to meet high performance aerospace applications and our Program Managers work with our customers to develop and provide realistic performance and delivery schedules.

4 II-VI A&D Optical Design and Fabrication Capabilities

II-VI A&D has a strong history of success in producing high quality aerospace optical components and assemblies. The company was founded in 1971 to provide silicon material for defense applications. Over the years, II-VI A&D has grown to provide optical subassemblies, windows, window assemblies and optics in a wide range of materials to our customers supporting the defense marketplace.

Our team has all the design and analysis tools, manufacturing and test facilities, and qualified personnel required for supporting SINTRA. Our design team uses Zemax for optical modeling and analysis; Fred and TracePro for stray light analysis; SolidWorks for mechanical design; Cosmos, CosmosWorks and MathCad for analysis. II-VI A&D has extensive experience working with a wide range of materials for optics and optical structures, including ZeroDur. ULE, Aluminum, silicon, carbon fiber, Invar, beryllium, silicon carbide, and composite materials. We can execute the design, manufacture, integration, and test of the SINTRA optical system in our Murrieta and Tustin facilities

The strength of this team lies in its experience in developing precision optical systems; from requirements definition, through design, analysis, fabrication, optical testing, environmental test, AND correlating test results with performance predictions. This experience has given us added confidence and credibility in the development of space based optical hardware

Lens and mirror manufacturing, polishing and coating is performed using II-VI A&D Murrieta location superior optical polishing capabilities will be used to produce the lenses required to support the EO Assembly requirements which we know will have an impact on the overall system performance and operation. Figure 5 shows photographs illustrating optical components that we have fabricated using our polishing capabilities and that will be available to fully support the requirements for the SINTRA program.



Figure 5: II-VI A&D Optical Fabrication Capabilities

II-VI A&D's capabilities include:

- Reflective and Refractive Optics production and manufacturing capabilities supporting customer needs for Imaging EO/IR and Laser Optics
- Window assemblies; IR and Visible Windows
- Large Sapphire windows and window assemblies.
- Opto-Mechanical and Electro-Optical Subassemblies
- Laser Optics coating capabilities including 7 E-Gun Chambers/3 with IAD and 3 IBS Chambers
- Thin Film Coating Engineering and chambers for High Efficiency Anti-Reflection, Hard Carbon (DLC), Reflective, and Conductive/EMI shielding through coating or grids.
- EMI Gridding; RF Coatings; L/O Material Manufacture
- Diamond Turned Optics to include: Telescope Assemblies, IR Lens Assemblies, Diffractive Optics, Axicons and Waxicons, Aspheric, Toroidal and Off-Axis Shapes, Polygons & Fold Mirrors, and Fresnels.
- Additional material growth capabilities for Sapphire, Silicon, Germanium and Laser Materials
- Hemispherical and segmented domes as well as dome assemblies.
- MWIR & LWIR Fixed Focus Objective Lenses
- MWIR & LWIR Motorized Continuous Zoom Lenses
- Beam Director Assemblies
- Coherent Beam Combined Fiber Laser Subsystems