

# **MOXTEK Supports NASA once again!**



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MOXTEK (Orem, UT) is excited to celebrate the launch of NASA's James Webb Space Telescope (JWST) on December 24<sup>th</sup> 2021. The launch of this telescope will be watched around the world with great anticipation as it is placed in orbit around the sun and begins searching for the first galaxies formed after the big bang. The JWST will serve as the premier deep space observatory for the next decade as the successor of the celebrated Hubble Telescope.



Photos Courtesy of NASA

# Our Story:

MOXTEK collaborated with 4D Technology, to develop a wire-grid pixelated polarizer for their dynamic laser interferometer which was used to measure the mirrors on NASA's long-awaited James Webb Space Telescope (JWST). Moxtek became involved with this project over a decade ago when NASA approached 4D Technology to develop an optical tool to measure the flatness of the JWST's telescope mirrors. At that time, there wasn't a measurement tool sensitive enough to measure the required mirror flatness. 4D Technology successfully developed an innovative approach using Moxtek's advanced pixelated polarizer, achieving NASA's challenging requirements.

#### Summary:

#### NASA's Challenge for 4D Technology:

- Develop the most sensitive instrument ever made for measuring mirror flatness.
- Current measurement tools were NOT sensitive enough to verify required flatness of the telescope mirrors.

### 4D Technology <u>Solution</u> with MOXTEK Polarizer:

- Developed a high-speed "dynamic" interferometer capable of achieving NASA's resolution requirements in long path, cryogenic, and vacuum testing environments.
- Interferometer captures 4 polarized phase images instantaneously, instead of capturing 4 separate frames over time and motion.
- Interferometer's 30 microsecond acquisition speed makes vibration and turbulence invisible.
- Moxtek's pixelated polarizer was essential to make this patented technology possible.







Simple Interferometer Design using a Moxtek Pixelated Polarizer



4D Technology PhaseCam interferometer (left), JWST mirrors (middle), Flatness measurement images (right). Images courtesy of NASA.



Moxtek Four-State Pixelated Polarizer Array:

What is a polarizer? A polarizer is an optical filter that passes light waves of a specific polarization while blocking light waves of other polarizations.



Scanning Electron Microscope (SEM) image of a Moxtek wire-grid polarizer. Moxtek wire-grid polarizer structures are very small. About 1,000 rib structures will fit inside the diameter of a human hair

https://moxtek.com/wp-content/uploads/OPT-DATA-1005-Pixelated-Polarizers.pdf

## JWST Launch Date: December 24, 2021 Launch Time: 05:20am MST

Watch Live: NASA TV broadcast from Mission Control

## Reference articles:

- <u>https://spinoff.nasa.gov/Spinoff2012/ip\_7.html</u>
- <u>https://www.spiedigitallibrary.org/conference-proceedings-of-</u> <u>spie/11813/118130U/High-speed-interferometry-for-James-Webb-Space-Telescope-</u> <u>testing/10.1117/12.2570872.short</u>
- <u>https://4dtechnology.com/2018/11/11/measuring-up-to-nasas-james-webb-space-telescope/</u>
- <a href="https://www.jwst.nasa.gov/content/about/comparisonWebbVsHubble.html">https://www.jwst.nasa.gov/content/about/comparisonWebbVsHubble.html</a>
- <a href="https://jwst.nasa.gov/content/webbLaunch/news.html">https://jwst.nasa.gov/content/webbLaunch/news.html</a>
- <u>https://youtu.be/LNLIKZeQabo</u>

### Fun Facts about the James Webb Space Telescope:

"As we're exploring more and more of the Universe, we're able to look farther away in space, which equates to farther back in time. The James Webb Space Telescope will take us to depths, directly, that our presentday observing facilities cannot match, with Webb's infrared eyes revealing the ultra-distant starlight that Hubble cannot hope to see. (NASA / JWST AND HST TEAMS)"



Photo Courtesy of NASA

JWST VS. HUBBLE TELESCOPE	JWST MISSION GOALS
<ul> <li>JWST is 100 times more powerful</li> </ul>	<ul> <li>Search for the first galaxies formed after the Big Bang</li> </ul>
<ul> <li>JWST mirror is 6 larger</li> </ul>	<ul> <li>Determine how galaxies have evolved</li> </ul>
<ul> <li>JWST can see IR wavelengths</li> </ul>	<ul> <li>Observe the formation of stars and the formation of</li> </ul>
<ul> <li>Hubble can see ~480 Million years after the</li> </ul>	planetary systems
Big Bang	<ul> <li>Measure the physical and chemical properties of</li> </ul>
• JWST can see ~250 Million years after the Big Bang	planetary systems
<ul> <li>Hubble orbits the Earth, James Webb does not</li> </ul>	<ul> <li>Investigate the potential for life in the Universe</li> </ul>

# **About Moxtek:**

MOXTEK is a leading developer and manufacturer of advanced nano-optical and x-ray components used in display electronics, imaging, and analytical instrumentation. For over 35 years, Moxtek has provided innovative, solution-based products and services focused on performance, quality, and value to customers all over the world. Since Moxtek was founded in 1986, they have been actively engaged in the development and manufacturing of innovative technology. Each year Moxtek products enable many new scientific discoveries across many fields and markets.

MOXTEK has successfully partnered with many prestigious businesses and research institutions. Today their products are used in a variety of x-ray and optical instruments all over the world.

#### X-ray Products

MOXTEK began its first research collaboration in 1986, resulting in an exciting breakthrough – the ultrathin polymer x-ray window which was quickly adopted by most semiconductor fabs and research institutions worldwide. From there, Moxtek began consistently releasing new breakthrough x-ray products for handheld and benchtop XRF and XRD applications and is well recognized for its contribution in these markets.

Moxtek's x-ray technology has revolutionized portable and handheld XRF instrumentation by developing miniature, durable, battery operated x-ray sources, windows, and detectors for on-site portable applications. Moxtek's x-ray sources have replaced hazardous and expensive radioactive isotopes previously used for portable applications resulting in lower cost of ownership and minimal environmental risk. Moxtek x-ray windows have improved the sensitivity of elemental mapping inside scanning electron microscopes used to make consumer electronics. Moxtek x-ray detectors are used by many XRF vendors because of the small size and dependable performance.

#### **Optics Products**

In 1998, Moxtek developed the first inorganic ProFlux wire grid polarizer. This polarizer allowed television and projector companies to increase the brightness of their projection systems while providing better contrast and image quality. This advantage revolutionized the projection display market and allowed consumers to "keep the light on" in the room while viewing television and while attending a business meetings. Moxtek was awarded the 2002 Silver Award by the Society for Information Display (SID) for the development of this polarizer.

Today, MOXTEK customizes their polarizers for many different applications including: Head-Mounted Display (HMD), Head-Up Display (HUD), scientific/medical/dental instruments, and security applications.

Moxtek's expertise in nano-structure design and high-volume manufacturing have enabled Moxtek to be the world's leading supplier of wire grid polarizers.

Moxtek manufactures all of their products in their Orem Utah (USA) factory. Moxtek also supports many local groups and charities and in interested in the continued success of our community.

### Previous Moxtek components in space:

- 2020 Mars Rover Perseverance (NASA X-ray Source & Windows)
- 2019 OCO-3 Orbiting Carbon Observatory (NASA Polarizers)
- 2019 Chandrayaan-2 XSM (Indian Space Agency X-ray window)
- 2015 Deep Space Climate Observatory (NASA Polarizers)
- 2014 OCO-2 Orbiting Carbon Observatory (NASA Polarizers)
- 2011 Mars Rover Curiosity (NASA X-ray Window)
- 2003 Mars Rover Opportunity (NASA X-ray Window)
- 2003 Mars Rover Spirit (NASA X-ray Window)
- 1999 EPIC Camera XMM-Newton (ESA X-ray Window)
- 1996 Mars Rover Sojourner (NASA X-ray window)

Moxtek is currently working on several more projects for future space flight missions.

For additional information, please contact: marketing@moxtek.com