Press Information

Kyocera installs world's first[1] Fine Cordierite ceramic mirror for International Space Station's experimental optical communications

Kyoto/London, 30th July 2024. Kyocera Corporations "Fine Cordierite" ceramic mirror has been chosen for use in experimental equipment to conduct optical communication between the International Space Station (ISS) and a mobile optical station on Earth. This is the first time[1] that cordierite has been adopted for such a purpose.

For more information regarding Kyocera's Fine Cordierite ceramic mirror, please click on this link or scan the QR code:
https://www.youtube.com/watch?v=1xf-m8gz7yM

Kyocera's Fine Cordierite ceramic mirror

Kyocera's Fine Cordierite ceramic mirror has been adopted in the optical communication antenna (Quantum-Small Optical Link, Hereinafter: QSOL) developed by Sony Computer Science Laboratories, Inc. (President and CEO: Hiroaki Kitano, Hereinafter: Sony CSL). Developed following a commission from Japan's Ministry of Internal Affairs and Communications, QSOL is an optical communication antenna component for the Secure Laser Communications Terminal for Low Earth Orbit, "SeCRETS", for on-orbit technology demonstration.

[1] First time a mirror made of cordierite ceramic was chosen for use in experimental optical communications equipment in the ISS, based on Kyocera research (2024).

This demonstration was conducted jointly by the National Institute of Information and Communications Technology (President: Hideyuki Tokuda, hereinafter: NICT), the School of Engineering, the University of Tokyo (Dean: Yasuhiro Kato), the Next Generation Space System Technology Research Association (President: Koji Yamaguchi), SKY Perfect JSAT Corporation (Representative Director, President and Chief Executive Officer: Eiichi Yonekura), and Sony CSL.

Background of material selection

The current method for two-way data communication between Earth observation satellites in space and ground stations involves using optical wireless communication with either radio waves or visible light. This communication is essential for acquiring image data for weather forecasting, disaster response, and infrastructure monitoring.

Advancements in the sensors installed on Earth observation satellites have resulted in an increased volume of obtainable observation data. However, there is a pressing need to rapidly transmit large amounts of observation data to ground stations. Achieving high-speed and high-capacity data communication has posed a challenge for space infrastructure. To address this issue, the implementation of laser-light optical communication is expected to enable data transmission and reception at speeds over 100 times faster than radio wave communication with significantly higher capacity.

Additionally, to transmit data from satellites to specific ground stations by optical communication, it is necessary to adjust the light to the optimal angle using optical mirrors. Conventionally, metal or glass mirrors have been used, but nanoscale precision is required for adjusting light. Therefore, mirrors with long-term stable dimensional accuracy and the ability to withstand thermal expansion and temperature changes in the harsh space environment are needed.

In this experiment, Kyocera's Fine Cordierite ceramic mirror was installed in QSOL due to its unique thermal and mechanical properties, such as low thermal expansion and long-term dimensional stability.

With the success of this experiment, we believe that our products can contribute to the construction of space infrastructure aimed at achieving high-speed and high-capacity data communication in satellite optical communication in the future.

Kyocera will continue to leverage its fine ceramic technology to develop reliable components that contribute to research and observation in the fields of astronomy and space.

Features of Kyocera's Fine Cordierite ceramic mirror

Kyocera's Fine Cordierite ceramic mirror possesses the following four properties, achieved through our fine ceramic material and firing technology developed over more than 65-years to enable stable optical communication even in space.

1. Low thermal expansion

The expansion and dimensional changes due to temperature variations are extremely small, making it possible to apply them to optical mirrors that require nanoscale precision.

2. High mechanical strength and high rigidity

Compared to low thermal expansion glass, Kyocera's Fine Cordierite ceramic mirror has 1.5 to 2 times higher mechanical strength, offering greater rigidity compared to glass and enabling weight reduction.

3. Long-term dimensional stability

Fine Cordierite exhibits excellent dimensional stability compared to low thermal expansion glass, allowing for use over extended periods without concern for dimensional changes.

4. Radiation resistance

Testing for radiation exposure confirmed that Fine Cordierite's coefficient of thermal expansion (CTE) remains unchanged, making it ideal for space applications.

Kyocera will exhibit its Fine Cordierite ceramic mirror at Space Tech Expo, to be held in Bremen, Germany from November 19 – 21, 2024. (Booth #T17)

For more information about Kyocera's cordierite ceramic mirror:

https://www.kyocera-fineceramics.de/en/markets/aviation-and-aerospace-industry

About the experiment

SeCRETS was launched towards the ISS on August 2, 2023, and installed on the external experiment platform of the "Kibo" Japanese Experiment Module (Intermediate Space Environment Experiment Platform [i-SEEP]). Subsequently, secret key sharing was carried out using 10GHz clock optical communication from the ISS in low orbit to a portable optical ground station on the ground, and further successfully demonstrated secure communication between the ISS and the ground station using one-time pad encryption with the key[2].

[2] Successfully achieved secret key sharing and highly secure communication between the ISS and ground. "Raising expectations for the practical application of satellite quantum encryption". https://www.sonycsl.co.jp/press/prs20240418/ (Japanese only).

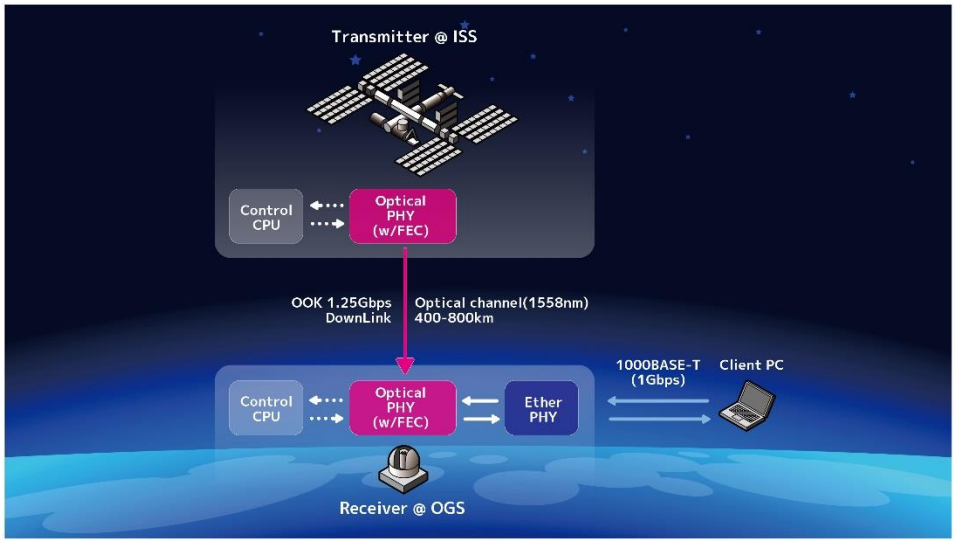
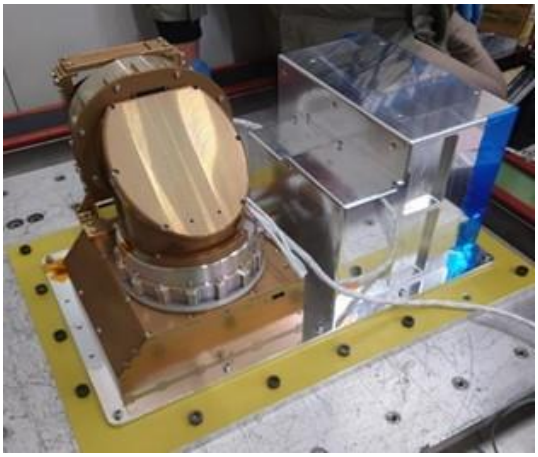


Diagram of the demonstration
Image by: Sony Computer Science Laboratories



Secure Laser Communications Terminal for Low Earth Orbit, "SeCRETS", equipped with Kyocera's Fine Cordierite ceramic mirror
Image by: National Institute of Information and Communications Technology, Sony Computer Science Laboratories, Next Generation Space System Technology Research Association

For more information about the experiments:
https://www.sonycsl.co.jp/press/prs20240423/?lang=en
SeCRETS was developed as part of the Ministry of Internal Affairs and Communication "Research and Development Project for Key ICT Technologies (JPMI00316)," specifically under "Research and Development of Quantum Cryptography Technology in Satellite Communications (JPJ007462)".[3]

[3] Ministry of Internal Affairs and Communications Press Release dated June 14, 2018. Results of the Public Offering for Research and Development Proposals in the 2018 Information and Communication Technology Field; http://www.soumu.go.jp/menu_news/s-news/01tsushin03_02000247.html

For more information on Kyocera: uk.kyocera.com

About Kyocera

Kyocera has been successful in Europe for over 50 years. From its European headquarters in Esslingen am Neckar, KYOCERA Europe GmbH operates 26 sites including manufacturing facilities, with products ranging from fine ceramics, electronics, automotive, semiconductor and optical components to industrial tools, LCDs, touch solutions, industrial printing components, solar systems and consumer goods such as kitchen and office products.

Kyocera's high-performance ceramic products are produced and distributed by KYOCERA Fineceramics Europe GmbH, a subsidiary of KYOCERA Europe GmbH. The Kyocera Group is one of the world's leading providers of high-performance ceramic components for the technology industry, offering over 200 different ceramic materials, as well as state-of-the-art technologies and services tailored to the specific needs of each market.

KYOCERA Europe GmbH is a company of the KYOCERA Corporation headquartered in Kyoto/Japan, a world leader in semiconductor, industrial and automotive components as well as electronic components, printing and multifunction systems, and communications technology. The technology group is one of the world's most experienced manufacturers of smart energy systems, with more than 45 years of industry expertise. The Kyocera Group comprises 292 subsidiaries (31 March 2024). In England, Kyocera has a subsidiary in Frimley, KYOCERA Fineceramics Ltd. With around 79,200 employees, Kyocera generated net annual sales of around EUR 12.29 billion in the 2023/2024 fiscal year.

Kyocera is ranked 672 on Forbes magazine's 'Global 2000' list for 2023, and ranked as 'The 100 Most Sustainably Managed Companies in the World' according to the Wall Street Journal. For the second year in a row, Kyocera qualified for the Dow Jones Sustainability Index (Asia-Pacific). As well, Kyocera receives a Gold rating on EcoVadis Sustainability Survey for the second consecutive year and was acknowledged as a 'Top 100 Global Innovator 2023', being one of the world's leading innovators, for the eighth time by Clarivate.

The company also takes an active interest in cultural affairs. The Kyoto Prize, a prominent international award, is presented each year by the Inamori Foundation — established by Kyocera founder Dr Kazuo Inamori — to individuals worldwide who have contributed significantly to the scientific, cultural, and spiritual betterment of humankind (equivalent to approximately €596,500 per prize category).

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