

February 26, 2025

<Press Release>

Kyocera Corporation

Kyocera Develops Transmission-Type Metasurface Film to Redirect Radio Waves

*Expanding Service Areas for Next-Generation Wireless Communications such as
Millimeter-Wave 5G*

Kyocera Corporation (*Kyoto, Japan; President: Hideo Tanimoto*) is pleased to announce the development of a new transmission-type metasurface film capable of redirecting radio waves in a desired direction. This innovative metasurface film can be applied to surfaces such as window glass and acrylic stands, expanding the service area of millimeter-wave 5G and 6G networks while maintaining aesthetic considerations.



(Transmission-type metasurface film)



(Application example)

Development Background:

Millimeter-wave signals (28GHz band) used in 5G and even higher frequency bands under consideration for 6G have a high degree of rectilinear propagation. As a result, obstacles can disrupt the line-of-sight from base stations, leading to degraded communication quality. To address this challenge, Kyocera has been developing transmission-type metasurface plates*¹ that can bend radio waves from base stations. The newly developed transparent and flexible metasurface film offers a solution that prioritizes both aesthetics and ease of installation. This allows users to select the appropriate solution based on environmental needs, such as choosing the conventional substrate-based metasurface plates for durability or the new metasurface film for aesthetic sensitive areas.

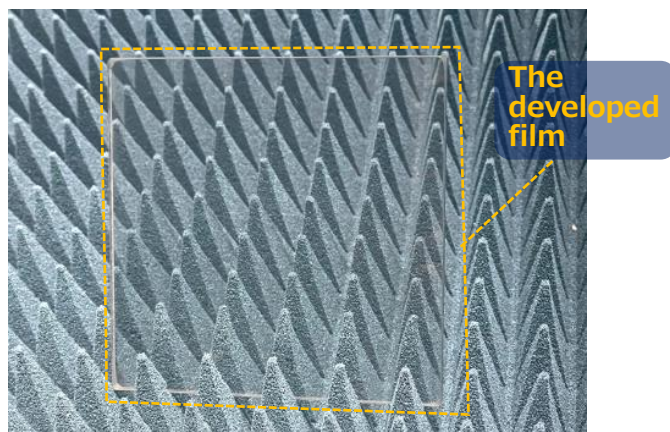
*1 More information on Kyocera's conventional transmission-type metasurface plates:

<https://www.kyocera.co.jp/newsroom/news/2022/001852.html>

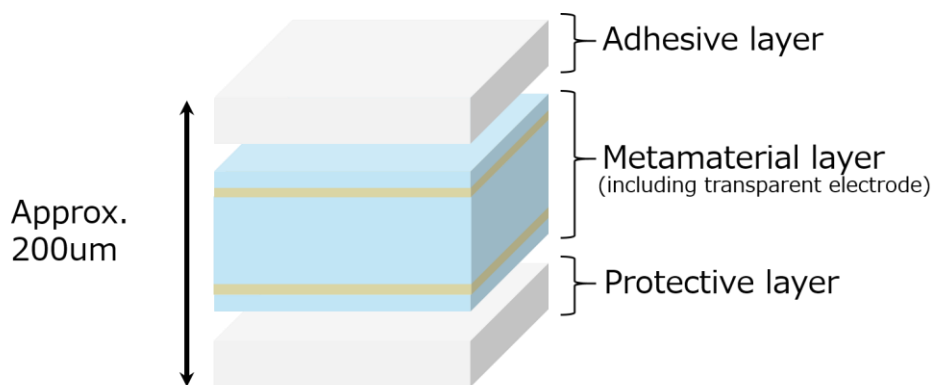
Key Advantages of the New Film:

1. Thin, Flexible, and Transparent Film for Easy Installation

With Kyocera's proprietary element structure, the film maintains high radio wave refraction properties comparable to conventional metasurface plates in a flexible film. It consists of three layers: an adhesive layer, a metamaterial layer, and a protective layer, with an overall thickness of approximately $200\ \mu\text{m}$. This ultra-thin structure allows for easy installation without special construction, enabling simple attachment to windows, acrylic stands, and other existing structures to function as a radio wave relay point for expanding service areas.



(Transmission-type metasurface film)



(Layer structure of Kyocera's metasurface film)

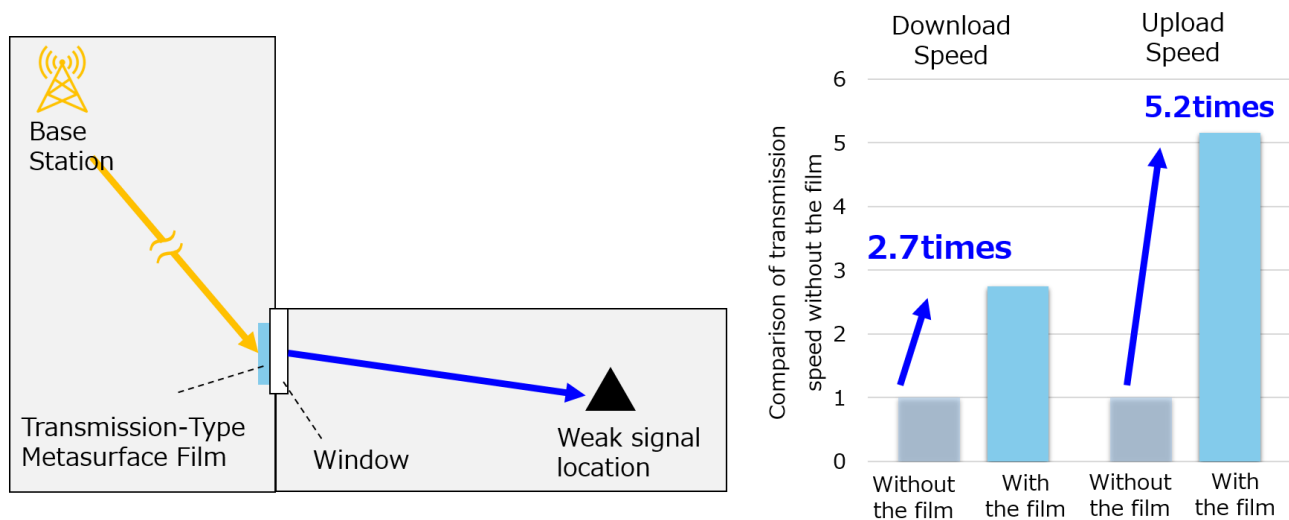
Additionally, the metamaterial layer incorporates transparent conductive electrodes, achieving a visible light transmittance of more than 80%. This ensures minimal impact on the aesthetics of the attached structure while allowing for installations in environments where maintaining scenic integrity is essential. Furthermore, its flexibility supports installation on curved surfaces.

2. Customizable Sizes and Configurations for Flexible Network Design

In general, the coverage area of metasurface films and plates increases in proportion to their size. Conventional metasurface plates can be custom manufactured in different sizes, but their rigid nature makes resizing difficult after production. In contrast, the newly developed metasurface film can be cut to the desired size post-production and combined with multiple sheets to create a larger refraction surface. Additionally, the refraction angle can be selected from a range of 0 to 60 degrees, allowing for highly flexible beamforming design and optimized service area expansion.

Experimental Results Using 5G Millimeter-Wave Signals:

Kyocera conducted tests in an indoor millimeter-wave (28GHz) 5G environment to evaluate the effectiveness of the metasurface film. In these tests, a mobile device was placed in an area with weak signal coverage from the base station, resulting in low signal reception. When the metasurface film was applied to a window glass, the transmission speed was observed to improve significantly, with download speeds increasing by up to 2.7 times and upload speeds improving by up to 5.2 times.



(Effect verification test using 5G base station)

Kyocera has been at the forefront of addressing coverage challenges in 5G and 6G communications through advanced metasurface technology development. With the goal of real-world implementation, Kyocera will continue working toward the commercialization of its transmission-type metasurface film. Moving forward, the Company will remain committed to developing new and innovative solutions that contribute to the advancement of the telecommunications industry and society as a whole.



About Kyocera's Participation in MWC 2025:

Kyocera will showcase its transmission-type metasurface film at Mobile World Congress 2025 (MWC), the world's largest communications technology convention, in Barcelona, Spain, March 3-6, 2025.

Dates	March 3-6, 2025
Official Website	https://www.mwcbarcelona.com/
Venue	Fira Gran Via, Barcelona, Spain
Kyocera Booth	Hall 5, 5E12

About KYOCERA

[Kyocera Corporation](https://global.kyocera.com/) (TOKYO:6971, <https://global.kyocera.com/>), the parent and global headquarters of the Kyocera Group, was founded in 1959 as a producer of fine ceramics (also known as “advanced ceramics”). By combining these engineered materials with metals and integrating them with other technologies, Kyocera has become a leading supplier of industrial and automotive components, semiconductor packages, electronic devices, smart energy systems, printers, copiers, and mobile phones. During the year ended March 31, 2024, the company's consolidated sales revenue totaled 2 trillion yen (approx. US\$13.3 billion). Kyocera is ranked #672 on *Forbes* magazine's 2023 “Global 2000” list of the world's largest publicly traded companies, and has been named among “The World's 100 Most Sustainably Managed Companies” by *The Wall Street Journal*.

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