

Press Information

Kyocera develops transmission-type metasurface film to redirect radio waves

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

Kyoto/London, 6th March 2025. The Kyocera Corporation has developed 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 plates¹ 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. The technology 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.

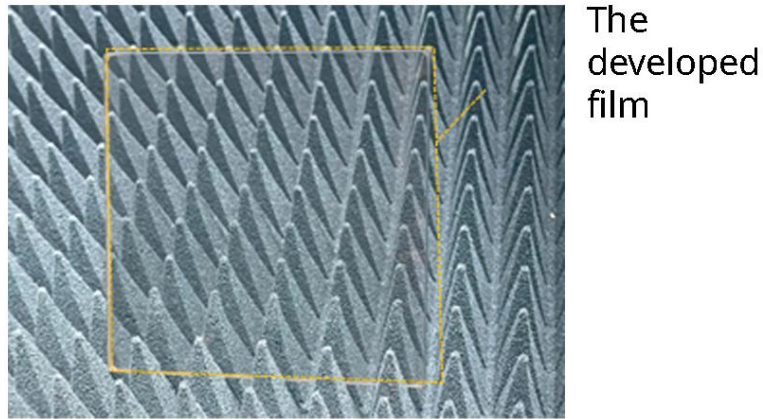
¹ More information on Kyocera's conventional transmission-type metasurface plates:

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

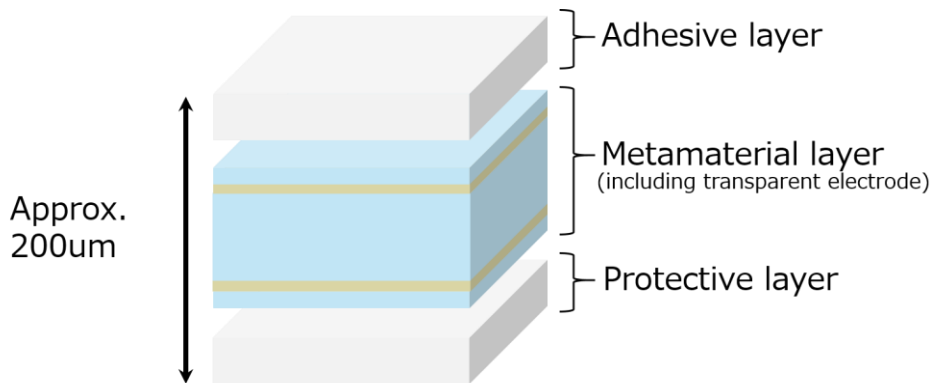
Key advantages of the new film:

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 while achieving a flexible film form factor. It consists of three layers: an adhesive layer, a metamaterial layer, and a protective layer, with an overall thickness of approximately 200 μ 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

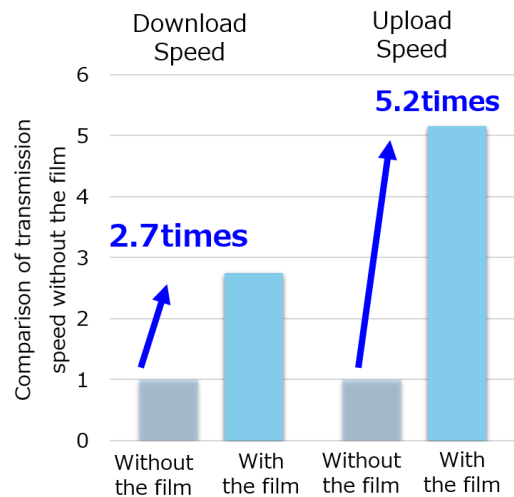
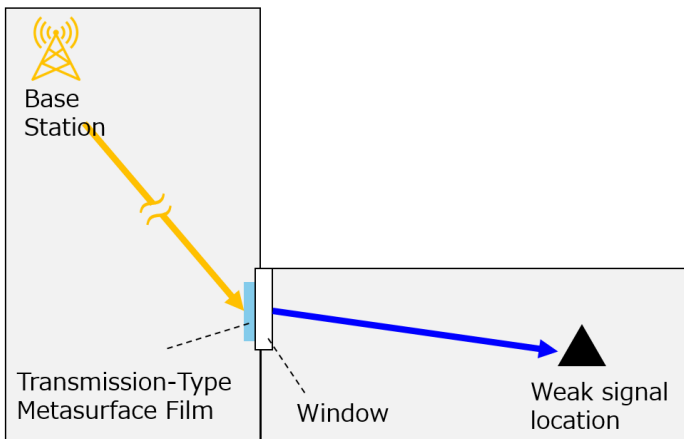
Additionally, the metamaterial layer incorporates transparent conductive electrodes, achieving a visible light transmittance of over 80%. This ensures minimal impact on the aesthetics of the attached structure while allowing for installations in environments where maintaining scenic integrity is essential. 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, we 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.

Overview: Kyocera at MWC 2025

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|-----------------|--------------------------------------------------|
| Show | Mobile World Congress 2025 (MWC) |
| Date | March 3-6, 2025 |
| Location | Fira Gran Via, Barcelona, Spain |
| Kyocera's booth | Hall 5, Booth #5E12 |

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 28 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 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 874 on Forbes magazine's 'Global 2000' list for 2024, 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 Bronze rating on EcoVadis Sustainability Survey and was acknowledged as a 'Top 100 Global Innovator 2023' for the second consecutive year, being one of the world's leading innovators, for the eighth time by Clarivate.

Kyocera 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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