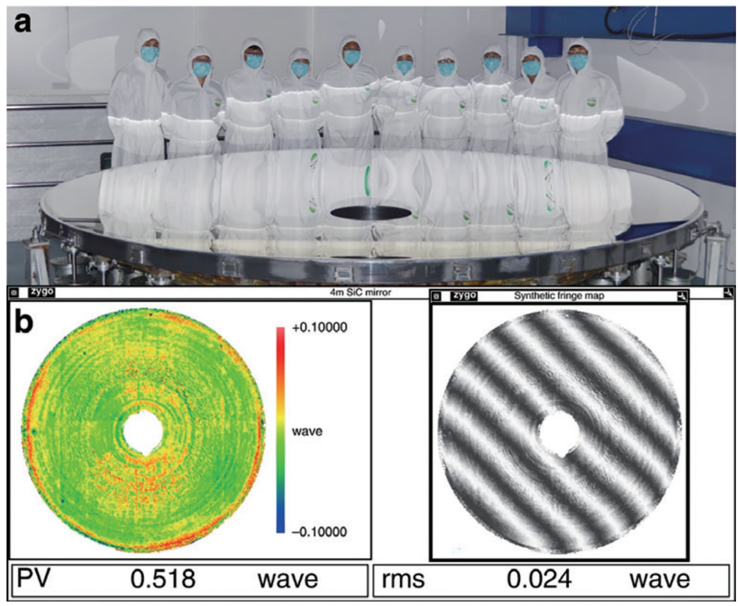
# Researchers Develop World's Largest Silicon Carbide Aspheric Mirror for Telescope Applications

By YAN Fusheng (Staff Reporter)

A team of researchers led by Dr. ZHANG Xuejun at the Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP) of the Chinese Academy of Sciences has successfully created the world's largest silicon carbide (SiC) aspheric mirror, measuring 4 meters in diameter. The achievement, which can potentially improve telescopes' imaging quality and detection capabilities, was published online in *Light: Science & Applications* on October 26.

Aspheric mirrors are commonly used in high-end optoelectronic instruments, such as astronomical telescopes and high-performance cameras. A telescope's performance is closely related to its aperture size, with larger apertures offering improved imaging quality. However, manufacturing large aspherical mirrors comes with its own challenges, particularly when it comes to selecting appropriate materials and minimizing surface inaccuracies that introduce aberrations, scattering, or loss of light.

Silicon carbide is a compound of silicon and carbon, known for its excellent mechanical properties, such as high thermal conductivity, low thermal expansion, high hardness, and resistance to wear and corrosion. These properties make it an attractive material for large aperture mirrors. Despite these benefits, fabricating large SiC mirrors (those with a diameter greater than 2 meters) remains challenging due to the complex physical phase changes and chemical reactions during manufacturing.




Fabrication of a 4.03-meter silicon carbide (SiC) aspheric mirror. (Image by CIOMP)

Researchers at the CIOMP have been working to develop a complete process for manufacturing large optical-class SiC mirrors. Their approach encompasses mirror blank preparation through the reaction-bonding process, aspherical surface computer numerical control (CNC) generation, computer-controlled optical surfacing (CCOS), Si cladding on the substrate surface using a physical vapor deposition (PVD) process, and high-accuracy asphere computer-generated hologram (CGH) interferometry.

The final mirror achieved a surface figure error of 15.2 nm RMS (root-mean-square) and a surface roughness of 0.8 nm RMS. The successful creation of the 4-meter SiC aspheric mirror demonstrates the potential for large-aperture, lightweight telescope mirrors made from SiC.

While the technology for polishing optical-class SiC mirrors larger than 2.5 meters is not yet commercially available, this work represents a notable advancement. The potential for this technology to improve the performance of advanced telescopes in both ground and space-based applications is an exciting prospect for astronomy and earth observation.

This technique, along with progress in large-scale, lightweight flat optical components and segmented mirror strategies, may contribute to the evolution of the next generation of engineering optics, according to the researchers in their article.

**References**

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