Researchers investigate new mixture material used for quarter-wave plate laser beam splitter

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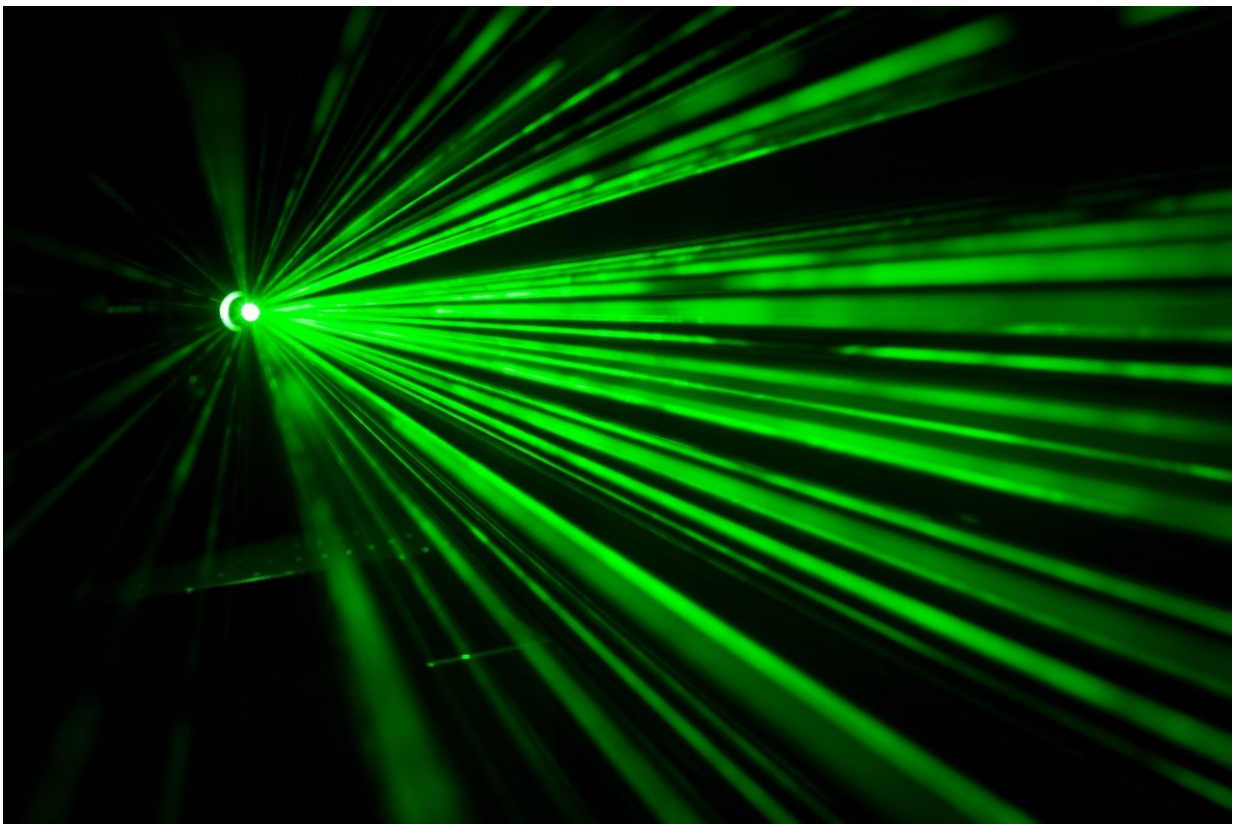

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Researchers from the Shanghai Institute of Optics and Fine Mechanics of the Chinese Academy of Sciences have made progress in the

preparation of mixture-based quarter-wave plate laser beam splitter (PLBS) coatings to improve the performance of the coating. The results were published in *Optics & Laser Technology*.

The plate beam splitters are widely used in quantum communication, measurement and laser systems due to their unique optical properties. The plate beam splitter used in high-power laser systems must achieve specific spectral performance. To meet the ever-increasing output power requirements of laser systems, it also requires a high laser damage threshold.

Mixture coating materials have attracted great attentions in the field of high-power laser coatings in recent years because of their tunable refractive index and optical bandgap. They have been used in the design and preparation of coatings such as high-reflective coatings, polarizer coatings, and dichroic mirror coatings. In order to obtain a specific intensity-splitting ratio, one or more non-quarter-wave layers are often required in the coating structure of the PLBS coatings, which leads to an increase in the electric field intensity and in the difficulty of controlling the coating layer thickness.

In this study, researchers realized the tuning of the mixture material by tuning the ratio of the two materials in it, and then used the quarter-wave coating structure to realize the PLBS coating with arbitrary T/R ratios.

By studying the optical and mechanical properties of the mixture coatings under different mixture ratios, the properties of PLBS coatings were compared. Two mixture based PLBS coatings using HfO_2–Al_2O_3 mixture material as high-n layer and SiO_2 as low-n layer were experimentally demonstrated. Then, researchers compared the former two mixture based PLBS coatings with a traditional PLBS coating using HfO_2 and SiO_2 as high-n and low-n layers.

The above results showed that the mixture-based PLBS coatings have lower surface roughness, larger intensity-splitting bandwidth, and nearly double the laser damage threshold (1064 nm). For applications with smaller bandwidth requirements, the laser damage threshold can be improved by a factor of ~2.6.

Therefore, the PLBS coating prepared based on the mixture material can not only yield better performance, but also simplify the design and fabrication process.

More information: Wenyun Du et al, Plate laser beam splitter with mixture-based quarter-wave coating design, *Optics & Laser Technology* (2022). DOI: 10.1016/j.optlastec.2022.108399

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