新型 pancake 光学设计引领下一代虚拟与混合现实显示技术革新

DOI: 10.12086/oee.2025.251006.h02

与传统的菲涅耳透镜和折射透镜相比，目前基于偏振的折叠光学系统，即 pancake 光学系统，已在实现 VR 头显的紧凑轻便方面发挥了关键作用。然而，由于折叠光路中使用一片半透半反镜，这种设计在本质上存在着较高的光学损耗。因此，为了提高 VR 头显的续航时间并保持紧凑轻便的性能，迫切需要发展新的光学结构设计。

来自美国中佛罗里达大学的吴诗聪教授团队主要专注于 AR、VR 和 MR 显示的研究。最近，他们推出了一种旨在改革下一代 VR 和 MR 显示系统的创新型 pancake 光学系统。该研究团队提出了一种新型无损耗的 pancake 光学系统。新设计由一个非互易偏振旋转器和两个反射型偏振片组成。与互易性偏振旋转器相比，无论光在介质中正向或逆向传播，非互易偏振旋转器都会沿着同一个方向旋转线偏振光。

该研究团队通过充分利用非互易偏振旋转器的特性，提出了一种新型无损耗的 pancake 光学系统。实验结果生动地展示了这一创新性的 pancake 光学系统对于下一代 VR 和 MR 头显具有巨大的潜力。此外，由于该设计对于在可见区域具有较大 Verdet 常数的非互易偏振旋转器薄膜的急迫需求，预计将激发未来磁光材料的下一轮发展。

Opto-Electronic Advances, 2024, **7**(3): 230178.
https://www.oejournal.org/article/doi/10.29026/oea.2024.230178

Revolutionizing next-generation VR and MR displays with a novel pancake optics

DOI: 10.12086/oee.2025.251006.h02

Polarization-based folded optics has emerged as a pivotal breakthrough for compact and lightweight VR headsets in the past few years. The employed half mirror causes a tremendous optical loss. Therefore, a novel optical structure with the same folding capability as the pancake lens, while without the optical loss is in urgent need.

The research group of Prof. Shin-Tson Wu have extensively explored light engines, imaging optics, and power consumption of AR, VR and MR displays. A game-changing pancake optics system for reducing the volume of VR and MR displays, while keeping a high efficiency is proposed by this article. The motivation behind this research is the increasing demand for wearable VR/MR headsets that are not only visually impressive but also comfortable for extended use.

This work demonstrates the potential that such a novel pancake optics system could revolutionize next-generation VR and MR displays with lightweight, compact form factor, and low power consumption. Besides, the pressing need for a thin-film Faraday rotator that is both magnetless and highly transparent, while possessing a large Verdet constant in the visible region, is expected to inspire the next-round magneto-optic material development in the future.

Opto-Electronic Advances, 2024, **7**(3): 230178.
https://www.oejournal.org/article/doi/10.29026/oea.2024.230178