KENT STATE UNIVERSITY
TECHNOLOGY TRANSFER

Adaptive Liquid Crystal Optics

Liquid crystal technology with variable pre-tilt control for advanced optics and displays.

TECH ID
KSU 356

Tech Categories
Advanced Liquid Crystal Displays
Tunable Optical Lenses
Light Modulation
Advanced Optic

Colleges
KSU Arts and Sciences
Advanced Materials and Liquid Crystal Institute
CSU, Sacramento
College of Natural Sciences and Mathematics

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The Need
Advancements in display and optical technologies require precise liquid crystal alignment to improve performance in AR/VR, tunable lenses, and biomedical imaging. Traditional liquid crystal devices lack dynamic birefringence control, limiting their effectiveness in adaptive optics and high-performance imaging. A technology enabling variable pre-tilt control can enhance efficiency, reduce manufacturing complexity, and enable next-generation optical solutions

The Technology
Researchers at Kent State and California State University, Sacramento developed a technology enabling the fabrication of liquid crystal cells and lenses with variable pre-tilt angles, allowing precise control over birefringence across different device regions. Unlike conventional liquid crystal alignment techniques that rely on uniform pre-tilt angles, this method introduces spatially varying pre-tilt to optimize optical performance. By carefully controlling the liquid crystal orientation during the manufacturing process, the technology enables tailored phase retardation and light modulation, leading to improved optical clarity, reduced distortion, and enhanced response times. The ability to manipulate birefringence dynamically without mechanical components makes this technology well-suited for applications requiring adaptive optics, such as tunable lenses, AR/VR headsets, and high-resolution imaging systems. It also improves energy efficiency by minimizing power consumption compared to traditional liquid crystal devices. Additionally, this approach simplifies the manufacturing process by reducing the need for complex electrode structures, making it a cost-effective solution for producing high-performance liquid crystal-based optical components.

Commercial Applications
This technology can improve AR/VR headsets by enhancing optical clarity and focus control. Tunable liquid crystal lenses in autofocus cameras and biomedical imaging devices benefit from their ability to adjust dynamically. It also enables advanced light modulation in optical computing and holographic displays while supporting energy-efficient smart glasses and wearable displays.

Benefits/Advantages
- Enhanced optical control with precise birefringence adjustments for adaptive optics.
- Higher contrast and resolution in LCD-based and AR/VR displays.
- Compact and energy-efficient design that reduces power consumption.
- Versatile applications across consumer electronics, healthcare, and aerospace.
- Cost-effective manufacturing compared to competing tunable lens technologies.

Patents
U.S. 8,654,281

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