



## Tunable, Silicon-Based Fresnel Lenses

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**WARF: P140128US01**

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**The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a Fresnel zone plate that has adjustable focal length and is easily integrated with electronic circuits.**

### OVERVIEW

A Fresnel lens or 'zone plate' is a type of compact lens made of concentric rings that alternate between opaque and transparent materials. The design is lighter and smaller than conventional lenses. Given their size and flat surface, Fresnel lenses are attractive for miniaturized optical systems and integrated optics.

Problematically, typical Fresnel lenses have fixed focal lengths that cannot be adjusted, which limits their usefulness. A new design incorporating carbon nanotube forests was recently developed to improve focusing capabilities, allowing the lenses to perform more efficiently in optical data transfer and communications systems. Unfortunately, the fabrication process is expensive and heat intensive, and the lenses are tough to integrate with silicon-based electronic circuits.

### THE INVENTION

UW-Madison researchers have developed a new, silicon-based Fresnel lens that is simple to manufacture and has an adjustable focal length.

The lens is made of transparent and opaque rings. The set of opaque rings is etched with tightly spaced silicon nanowires. The structure is set on an elastic plate that can stretch to change the focal length of the lens.

### APPLICATIONS

- Optical interconnects, micro optics and chip-to-chip communications
- Miniaturized optical systems
- Integration into devices like cell phone cameras

### THE WARF ADVANTAGE

Since its founding in 1925 as the patenting and licensing organization for the University of Wisconsin-Madison, WARF has been working with business and industry to transform university research into products that benefit society. WARF intellectual property managers and licensing staff members are leaders in the field of university-based technology transfer. They are familiar with the intricacies of patenting, have worked with researchers in relevant disciplines, understand industries and markets, and have negotiated innovative licensing strategies to meet the individual needs of business clients.



## KEY BENEFITS

- Tunable and simple to manufacture
- Easy to integrate with electronic circuits
- Low cost
- No reliability or packaging concerns, unlike liquid-based lenses
- Straightforward to control
- Dynamic focal length opens up new possibilities and applications.

## STAGE OF DEVELOPMENT

The researchers successfully developed and experimented with Fresnel zone plates made of silicon nanowires on a flexible and stretchable PDMS substrate. An array of microscale lenses, wrapped on a curved surface, captured images with wide field of view as large as 175°. Fresnel lenses on flexible substrate were actuated mechanically to vibrate and in turn, scan optical focus and control the depth of imaging. The lenses were installed in a commercial microscope to capture images with high-resolution.

## ADDITIONAL INFORMATION

### Related Technologies

[WARF reference number P05131US describes hydrogel-based microlenses with adjustable focal lengths.](#)

### Publications

[Read a news story about this technology.](#)

[Read a news story about this technology.](#)

### Tech Fields

Analytical Instrumentation - Optics

## CONTACT INFORMATION

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