

# METASURFACES: NANO-OPTICS FOR PRECISION IMAGING

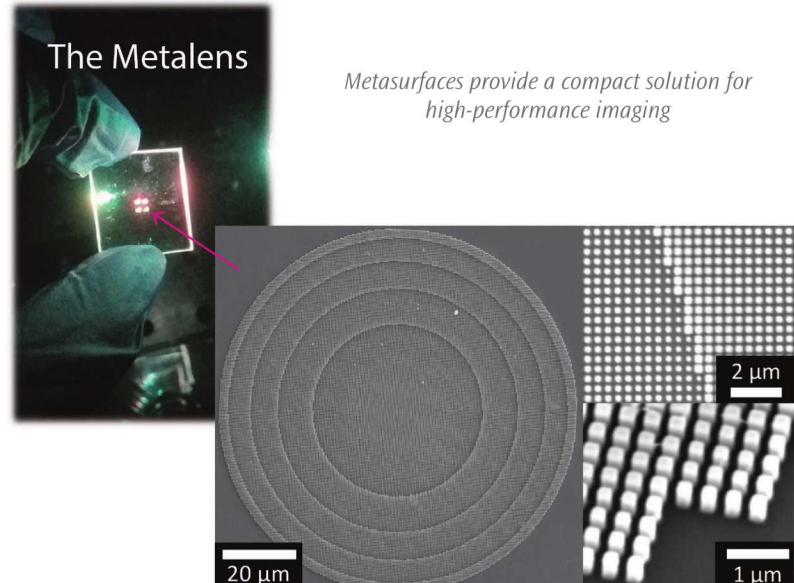
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US Patent Pending  
Technology Readiness Level: 3  
*Concept demonstrated analytically or experimentally*

**Metasurfaces provide an ultra-thin alternative to conventional glass optics.** Using advances in nanofabrication technology, metasurfaces mimic the focusing and imaging properties of refractive lenses, and achieve additional optical properties not found in nature. This technology is under active development at Sandia National Labs, and may lead to miniaturized, low-cost devices for medical imaging, consumer photography, and VR/AR display.

**Using metasurface technology, researchers at Sandia in collaboration with University of New Mexico have developed one of the world's smallest "zoom" lenses.** This device focuses light to different distances, depending upon the polarization state of the input beam. By combining this metasurface with an electrically modulated liquid crystal filter (a standard component already included in LCD displays) the metasurface achieves a continuously-tunable focal length without requiring any moving parts. In addition, this technology can remove unwanted image distortions and blurring by correcting chromatic aberrations. A tunable metalens has recently been demonstrated experimentally: A prototype 40  $\mu\text{m}$  diameter device achieved a focus-tunability range of approximately 800 diopters, and a numerical aperture of 0.05 – 0.09. **This technological advance eliminates the need for some of the bulky, mechanical assemblies normally used to refocus images.**

In ongoing work, Sandia scientists are developing compact metasurface optics to be used for smartphone-based medical imaging and microscopy. **Such devices could transform a standard cellphone into a powerful diagnostic tool for detecting pathogens and disease in resource-limited settings.**



Metasurfaces provide a compact solution for high-performance imaging

## INDUSTRIES & APPLICATIONS

- Consumer Photography
- Medical imaging
- Point-of-care diagnostics
- VR/AR display
- Telecommunications

## TECHNICAL BENEFITS

- Compact, low cost alternative to traditional zoom lenses
- Eliminates moving parts and complex optical assemblies
- Correction of chromatic aberrations