

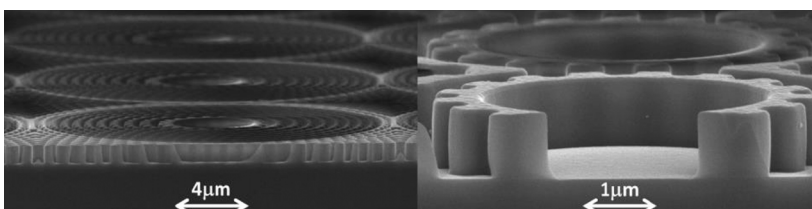
# Flat Optics: stand-alone on glass or integrated at pixel level

At imec, we develop flat optics components (filter, polarizer, lens etc..) to enable your specific application in the visible and IR (e.g. light field/3D display and camera, polarimetric imaging, spectroscopy, micro-LED, smart glasses etc..). These components can be processed on glass for stand-alone applications or stacked, post-processed on top of device wafers and optimized at pixel-level.

## Key benefits

Advantages of flat optics as compared to macro-optics and standard polymer optics are:

- Higher process tolerance, design flexibility and material flexibility
- Ideal alignment at pixel level that is not possible with standard approach
- Pixel-level optimization of Quantum Efficiency (QE) and directionality
- Compatibility with further post-processing (polarizer, plenoptics, colour filters)
- Enhanced form factor and ultra-compact optical elements compared to standard optical element
- Processing on Si directly on top of or on glass (200mm or 300mm)



Two Flat Optics lenses processed on the same wafer with 2 different designs, proving the highly designability of flat optics.

## Applications

### Camera

- Lens optimized at pixel level for non-uniform illumination compensation
- 3D/light field
- Light pipe for cross-talk management (i.e. isolation)
- Spectral imaging
- Novel applications: Polarimetric 3D, Polarimetric glare compensation

### Display

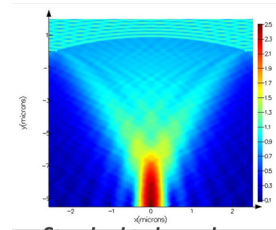
- Directive display
- 3D/light field display
- Pixel enhancement polarization/illumination/selection
- MicroLed integrated lens

### Glasses

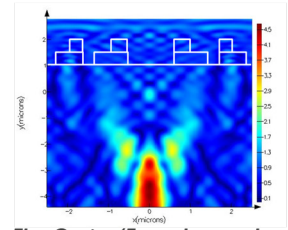
- Light in couplers
- Light guide
- mirrors
- Diffuser
- Scatters

### Sensors

- Spectrometers on chip
- Fluorescence imaging
- Screening Sorting

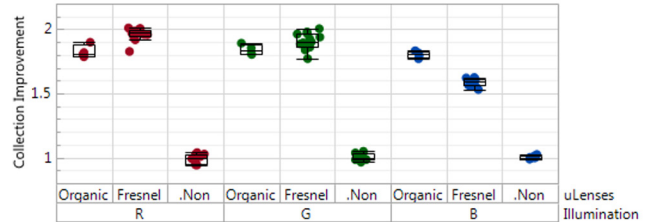


Standard polymer lens

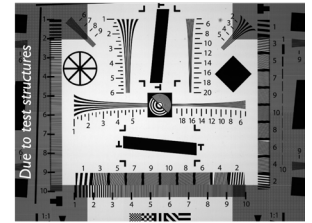
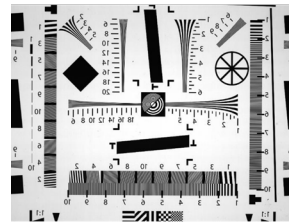


Flat Optics (Fresnel zone plate)

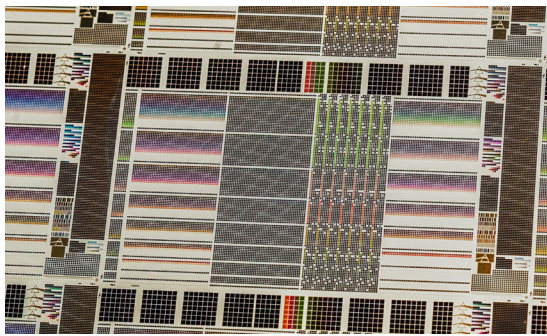
Field intensity simulation of focusing through standard and flat optics lens. The three (3) zone plate Fresnel lens achieves a performance that is comparable or better than a standard lens.



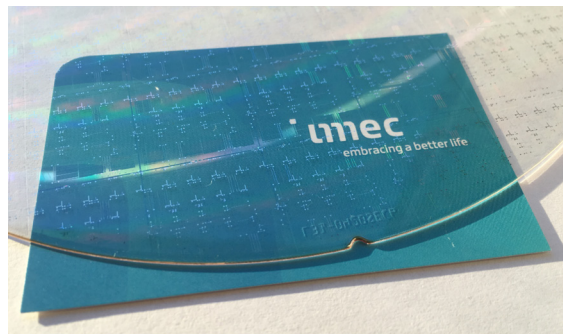
Direct comparison of Organic lens, imec's flat lens and no lens for Red, Green and Blue. Imec's flat lens shows a comparable or better performance than Organic lens while proving higher design flexibility.



Resolution measurement obtained by mounting flat optics directly on top of a camera. The flat lens preserves native resolution and MTF.



Color filter by design single stack addressing all colors.



Flat optics processed on 200mm/8-inch quartz in imec's CMOS line.

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