Docket #: S21-246

Geometric-Phase Metasurface Optofluidics for Microlens-Free Planar Light-Field Displays (combined with 21-247)

As part of a comprehensive optofluidic platform, researchers at Stanford have developed an integrated dynamic flat-optics system enabling microlens-free metasurface planar light-field displays. This technology is realized in a microfluidic system by flowing liquids with different refractive indices on top of light-field pixels having subwavelength-thick, engineered silicon nanoresonator arrays. This technology enables the dynamic intensity control of light-field pixels that can project light to arbitrary directions without the help of microlens arrays. Such a sub-micrometer-thick light-field pixel array can create different images for different viewing angles, mimicking the light scattered by real 3-D objects. By eliminating microlens arrays, the metasurface light-field display has a more compact configuration, collects and redirects light in a more efficient way, and also enables the possibility of reflective-type light-field displays.

This technology is part of a portfolio showing how the convergence of optofluidics and metasurface optics can lead to new platforms for dynamic control of light fields. Explore more:
S21-247 – an integrated system enabling on-demand transmissive flat optics and ultra-compact refractometers.
S21-249 – a new type of reflective display technology for achieving transparent displays.

Stage of Development
The Brongersma team has demonstrated that their comprehensive platform offers a **wide range** of fundamental dynamic control functions, is realized using the **same material** and by the **same processing**, and is **compatible** with mature

microfluidic integration technologies.

Applications

- Microlens-free metasurface planar light-field displays

Advantages

- Redirects the beam more efficiently (vs. Lambertian light source)
- Avoids the strange, unpleasant glazing effect from the microlens arrays
- Easy switch between light-field displays and conventional displays
- More compact configuration

Publications

- Li, Q., van de Groep, J., White, A.K. et al. Metasurface optofluidics for dynamic control of light fields. *Nat. Nanotechnol.* (2022).

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