Docket #: S21-249

Metasurface Optofluidics for Reflective Displays Integrated on Transparent Substrate

As part of a comprehensive optofluidic platform, researchers at Stanford have developed a new type of reflective display technology for achieving transparent displays, which allow users to receive visual information from the external world through the display at the same time. In this technology, the tunable pixel is realized in a microfluidic system by flowing transparent liquids (air) with different refractive indices on top of a subwavelength-thick, engineered silicon nanoresonator array on a transparent substrate. This technology allows the dynamic broadband reflectivity (brightness) tuning as well as wide-range color tuning of arbitrarily-shaped display pixels with sub-micrometer resolution without the use of inks/pigments, polarizers, color filters, backlight, or back reflectors. Unlike existing reflective displays on the market, this technology generates robust, vivid structural colors from highly designable optical resonances supported by the silicon nanoresonators, and therefore gets rid of use of any opaque elements that may impede the realization of see-through 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:
S21-246 – an integrated dynamic flat-optics system enabling microlens-free metasurface planar light-field displays.
S21-247 – an integrated system enabling on-demand transmissive flat optics and ultra-compact refractometers.

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

- Electronic papers, outdoor displays, transparent (see-through) displays, displays integrated on wearable devices

Advantages

- **Advantages of reflective displays (over LCDs and OLED displays)**:
  - Low power consumption
  - Sunlight readable
  - Paper-like quality is easy to eyes
- **Advantages over existing reflective display technologies (electrophoresis, electrowetting, interference-modulation)**:
  - Long term durability
  - Better structural color
  - No need to place a back reflector (can be transparent)
  - Display pixels down to sub-micrometer resolution

Publications

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

Patents

- Published Application: WO2023076256
- Published Application: 20240411052

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