

Hybrid Meta-Surfaces for Active, Non-Volatile Light Manipulation (#8530)

Useful for miniaturized energy harvesting and optical signal processing

This reconfigurable hybrid meta-surface platform incorporates the phase-change alloy germanium antimony telluride (GST) into metal-dielectric meta-atoms for active and non-volatile tuning purposes. The platform consists of a silicon (Si) nanostructure sitting on top of a GST or any other relevant phase-change material (PCM) layer deposited on an optically opaque gold (Au) back-reflector. The GST works as a functional dielectric medium whose optical properties can be tuned by applying a controllable external stimulus, such as a set of electrical pulses.

This Georgia Tech innovation lays a foundation for reconfigurable hybrid plasmonic-photonic meta-surfaces as promising candidates for the development of miniaturized energy-harvesting, optical-sensing, and imaging meta-systems. To determine feasibility, researchers experimentally demonstrated miniaturized tunable meta-surfaces that globally manipulate the amplitude and phase of incident light necessary for near-perfect absorption and anomalous/specular beam deflection.

Note: This innovation is related to technology [8437](#).

Benefits/Advantages

- **Fast:** Enables highly dense pixels with fast (nanosecond) switching capability
- **Scalable:** Can be fabricated with features down to nanometer sizes; the overall device can incorporate several meta-surfaces with different features over a large-size wafer
- **Agile:** Offers high switching robustness (up to 10^{12} cycles)
- **Thermally stable:** Withstands temperatures up to several hundred degrees
- **Flexible:** Adaptable with complementary metal oxide semiconductor (CMOS) technology

Potential Commercial Applications

- Light detection and ranging (LiDAR)
- Infrared sensors
- Energy harvesters
- Computational meta-systems
- Hyperspectral imagers
- Optical computing (e.g., brain-inspired computing)

Background/Context for This Invention

Well-engineered hybrid plasmonic-photonic platforms are necessary to simultaneously alleviate the intrinsic drawbacks and highlight the potential benefits of both metal-based and all-dielectric meta-surfaces. However, post-fabrication tunable hybrid meta-structures are limited by concerns regarding non-radiative losses, low-quality-factor modes, low damage thresholds, and restricted fundamental efficiencies.

New methodologies to make meta-surfaces programmable could revolutionize modern flat optics technology to surpass conventional spatial light modulators based on digital micromirrors and liquid crystal cells. This Georgia Tech innovation paves the way for dynamically tunable hybrid meta-surfaces.

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More Information

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Publications

[*Dynamic Hybrid Metasurfaces*](#), ResearchGate, August 2020

For more information about this technology, please visit:

<https://licensing.research.gatech.edu/technology/hybrid-meta-surfaces-active-non-volatile-light-manipulation>

Images:

The automated sequential delivery of multiple fluids. A varying number of delay gates imprinted in the branches are shown in the figure.

COVID-19 and flu saliva test on paper: (A) The automatic sequential delivery of multiple reagents required for virus test; (B) Water pouring into the device triggers the virus assay, allowing the presence of SARS-CoV-2 and influenza A & B viruses to be visually identified by the color changes in the corresponding detection spot