nanoComposix

6 Innovative Uses for Silver Nanocubes

Silver nanocubes offer a unique morphology that gives them a competitive advantage over other plasmonic nanomaterials for application in an array of emerging technologies including sensing, surface enhanced spectroscopy, metamaterials, catalysis, bionanotechnology, and more. At nanoComposix, our silver nanocubes are synthesized with precision and control to exhibit size and shape purity within a given material batch, and to ensure consistency lot-to-lot.

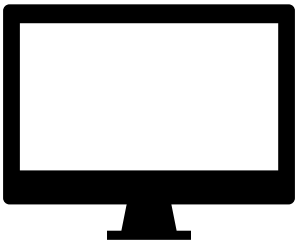
Please enjoy this literature overview to see how silver nanocubes are being used by researchers around the globe.

UNLOCKING MULTISPECTRAL IMAGING FOR SENSING

Silver nanocubes from nanoComposix were combined with layer-by-layer deposition and repeated lift-off photolithography to precisely control their placement on a silicone/gold wafer to create a plasmonic metasurface with tunable RGB pixels. The plasmonic pixel array was used to reconstruct a macroscopic RGB image, and demonstrates how silver cubes can be used to apply multispectral infrared imaging to a wide range of chemical and thermal sensing technologies. Potential areas of application range from monitoring environmental pollutants to detecting cancerous tissues.

Stewart, Akselrod, Smith, Mikkelsen. "Toward Multispectral Imaging with Colloidal Metasurface Pixels" *Adv. Mater.* **2017**, 1602971.

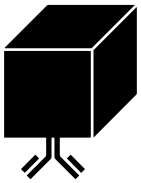
IMPROVING OLED STABILITY FOR TVS & MOBILE DISPLAYS



A recent *Nature* report shows how silver nanocubes can improve the stability of organic light-emitting devices (OLEDs). Today, the high-quality color profiles and low power consumption of OLEDs make them an essential part of lighting panels, TVs, and mobile displays. However, widespread use of OLEDs has been hindered by a process called "ageing" that limits their stability and efficiency. The study uses silver nanocubes to combat ageing and enhance stability up to 4× while maintaining device efficiency. Importantly, these new methods are not specific to any single material type so they may be used to improve all commercial OLEDs!

Fusella, M.A., Saramak, R., Bushati, R. et al. "Plasmonic enhancement of stability and brightness in organic light-emitting devices" *Nature* **2020**, 379–382.

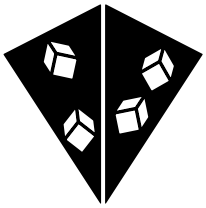
ULTRABRIGHT FLUORESCENCE FOR POINT-OF-CARE DIAGNOSTICS



Researchers at Duke University use nanoComposix silver nanocubes to demonstrate that the plasmonic nanogap cavity between cubes can be used to enhance the fluorescence in sandwich immunoassay microarrays up to 150 times! This is an important improvement that helps increase performance, simplify detection, and reduce cost for point-of-care diagnostic tests based on fluorescent protein microarray technologies.

Cruz, Fontes, Semeniak, Huang, Hucknall, Chilkoti, Mikkelsen. "Ultrabright Fluorescence Readout of an Ink-Jet Printed Immunoassay Using Plasmonic Nanogap Cavities" *Nano Lett.* **2020**, *20* (6), 4330–4336.

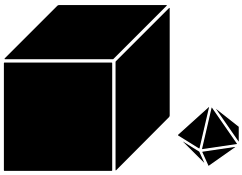
ENHANCING SENSITIVITY & RESOLUTION OF SURFACE-ENHANCED SPECTROSCOPY



Silver nanocubes have sharp corners that drastically intensify electric fields within extremely small spatial regions. These plasmonic hotspots enable detection of surface-enhanced Raman spectroscopy (SERS) from a single molecule, providing an effective platform for ultrasensitive detection. By using atomic force microscopy (AFM) tips coated with Ag nanocubes, tip-enhanced Raman spectroscopy (TERS) enables access to chemical information with nanoscale spatial resolution and single-molecule sensitivities.

Dill, Rozin, Palani, Tao. "Colloidal Nanoantennas for Hyperspectral Chemical Mapping" ACS Nano 2016, 10 (8), 7523–7531. / Akselrod, Argyropoulos, Hoang, Ciracì, Fang, Huang, Smith, Mikkelsen. "Probing the mechanisms of large Purcell enhancement in plasmonic nanoantennas" *Nat. Photonics* **2014**, *8*, 835–840.

ENGINEERING NANOPHOTONIC DEVICES



Silver nanocubes deposited on metal substrates separated by a thin dielectric spacer offer unique capabilities and the opportunity to engineer ultrabright single-photon light sources, lasers, and LEDs. Nanodiamonds in close proximity to silver cubes have modified spontaneous emission characteristics resulting in enhanced photon rates and unique spin capabilities, suggesting their use to design next-generation quantum information processing technologies.

Bogdanov, Shalaginov, Lagutchev, Chiang, Shah, Baburin, Ryzhikov, Rodionov, Kildishev, Boltasseva, Shalaev. "Ultrabright Room-Temperature Sub-Nanosecond Emission from Single Nitrogen-Vacancy Centers Coupled to Nanopatch Antennas" *Nano Lett.* **2018**, *18*, 4837–4844.

DESIGNING NANOSCALE SENSORS FOR HUMIDITY & OTHER GASES

Silver nanocubes exhibit plasmonic optical properties that are highly sensitive to their local spatial surroundings. In combination with Nafion, silver nanocubes are used to develop sensors with extreme sensitivity to humidity, a technology that can be extended to detect other gaseous species.

Powell, Coles, Taylor, Watt, Assender, Smith. "Plasmonic Gas Sensing Using Nanocube Patch Antennas" *Adv. Optical Mater.* **2016**, *4*, 634–642.

Additional literature reports that demonstrate the benefits of nanoComposix silver cubes:

- Belenkova, Govorov, Markovich. "Orientation Sensitive Peptide Induced Plasmonic Circular Dichroism in Silver Nanocubes" *J. Phys. Chem C* **2016**, *120* (23), 12751–12756.
- Mertens, Kleemann, Chikkaraddy, Narang, Baumberg. "How Light is Emitted by Plasmonic Metals" *Nano Lett.* **2017**, *17* (4), 2568–2574.
- Vijayan, Aindow. "Temperature calibration of TEM specimen heating holders by isothermal sublimation of silver nanocubes" *Ultramicroscopy* **2019**, *196*, 142–153.
- Wang, Zilli, Sztranyovsky, Langbein, Borri. "Quantitative optical microspectroscopy, electron microscopy, and modelling of individual silver nanocubes reveal surface compositional changes at the nanoscale" *Nanoscale Adv.* **2020**, *2*, 2485–2496.

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