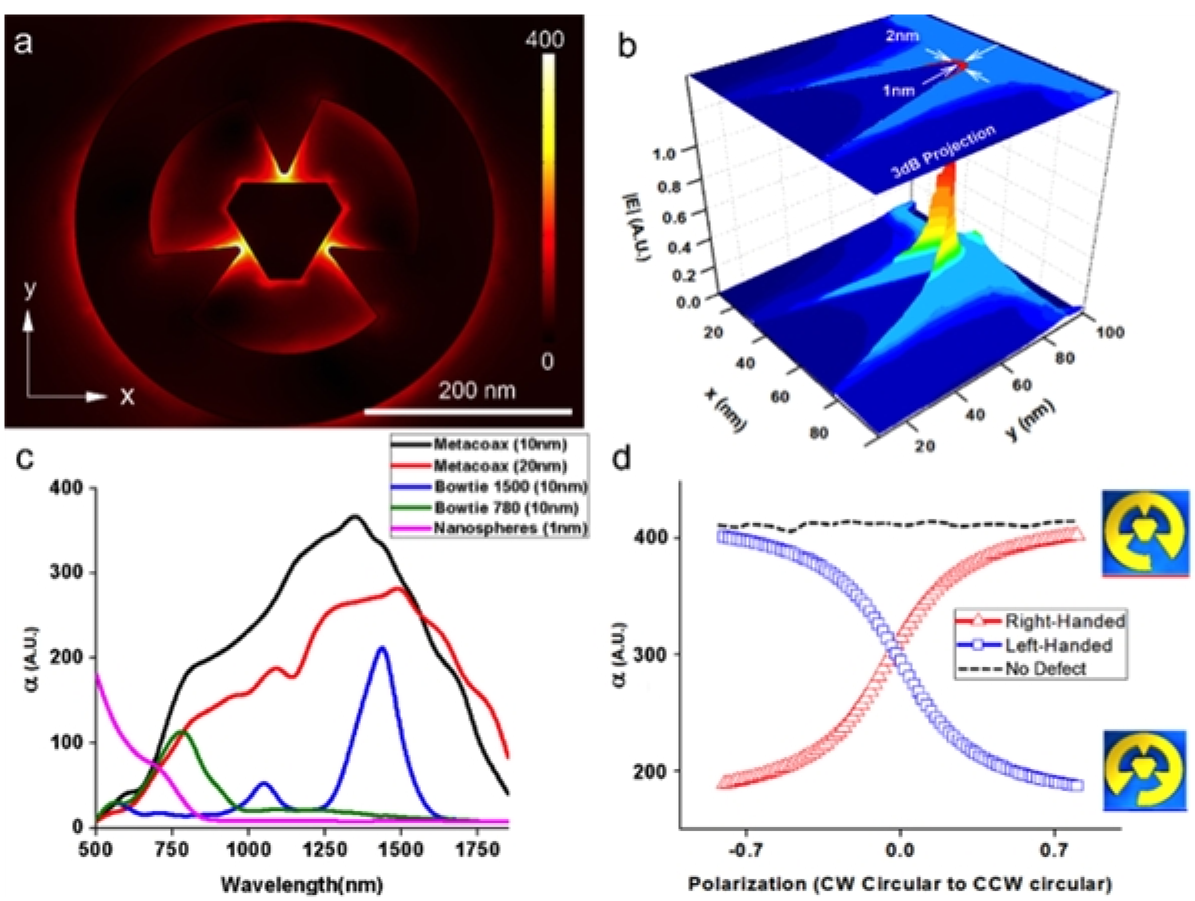
Broadband Metacoaxial Nanoantenna for Metasurface and Sensing Applications

Tech ID: 24770 / UC Case 2015-060-0

TECHNOLOGY DESCRIPTION

Introduced here is a metacoaxial nanoantenna (MN) that super-localizes the incident electromagnetic field to "hotspots" with a top-down area of 2 nm^2 , a local field enhancement of ~200-400, and a field localization with a very large spectral range from the visible to the infrared range that has a spectral bandwidth ≥900 nm. Not only is this nanoantenna extremely broadband with ultra-high localization, it also shows significant improvements over traditional nanoantenna designs, as the hotspots are re-configurable by breaking the circular symmetry which enables the ability to tailor the polarization response. These attributes offer significant improvements over traditional nanoantennas as building blocks for metasurfaces and enhanced biodetection that are demonstrated in this work.

The spatial field localization is of great interest for numerous applications that rely on the ***strength of the field*** in a ***broad spectral range*** of operation including surface-enhanced Raman spectroscopy (SERS), fluorescence enhancement, enhanced performance of photovoltaic solar cells, and single molecule fluorescence detection. Additionally, a metasurface consisting of metacoaxial nanoantennas could be used to make broadband ultrathin flat lenses and enhanced optical gradient trapping devices. For these applications, an ability to manipulate the response to the ***polarization state*** of the incident radiation is a very desirable property in a metasurface, as enabled by the present work.



Figures. (a) FEM simulation results of field distribution for excited localized plasmon mode of MN showing strong field localization at the tip geometry of each inner prong. (b) The numerical results showing spatial field localization of the MN; the 3dB projection shows the FWHM cross section of the "hotspot". E field is localized to a spot with an area at FWHM of ~1 nm x 2 nm. (c) Numerical results of local field enhancement, alpha vs wavelength (optical frequency) of the excitation field for MN and other antennas with various gap sizes. The local field enhancement of the MN has a very broad spectral response. This is due to the characteristics from the coaxial geometry where numerous transverse modes are supported by the antenna giving rise to spectrally broad band operation. (d) Numerical results of alpha for MN with left-handed and right-handed defects, showing asymmetric responses to excitation with optical fields prepared with clockwise and counterclockwise circular polarization states.

RELATED MATERIALS

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OTHER INFORMATION

CATEGORIZED AS

- **Materials & Chemicals**
  - Other
- **Sensors & Instrumentation**
  - Other

RELATED CASES

2015-060-0

▶ Smolyaninov A, Pang L, Freeman L, Abashin M, Fainman Y. "Broadband metacoaxial nanoantenna for metasurface adn sensing applications". Optics Express Vol. 22, Issue 19, pp 22786-22793, 2014.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	9,952,453	04/24/2018	2015-060

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