**Docket #:** S09-409

# Bowtie Nanoantennas for Enhancing Molecular Emissions

Researchers the laboratory of 2014 Nobel laureate Prof. W. E. Moerner developed nanoantennas that greatly enhance optical emissions for high sensitivity molecular detection. This invention renders previously undetectable molecules detectable by coupling plasmonic metal bowtie nanoantennas to fluorophores. This has been shown to increase fluorescence up to a factor of more than 1300. The nanoantennas enable easy detection of one molecule above the signal from 1,000 background molecules, allowing for high sensitivity detection in otherwise crowded environments. This technology allows for greater flexibility in designing fluorophores and other emitters with applications in biomedical diagnostics, microscopy, ultrasensitive detection, materials analysis, and single-photon sources.

The following papers show that the bowtie on a surface IN SOLUTION can detect a properly labeled object that is nearby, at high concentration. The label should be a poorly fluorescent molecule. If an enzyme is attached in the gap, and you have a labeled substrate in solution, the enhancement can detect hits when binding occurs. This also works for protein-protein interactions: tie one down, label the partners. This is similar to the zero-mode waveguide of Pacific Biosciences, but no hole is required (only bowties on the surface).

**Papers:**
"Fluorescence correlation spectroscopy at high concentrations using gold bowtie naoantenas"

"Supplementary Information"

## Applications

- **Super resolution microscopy**
- **Optical sensing of molecules for:**

    - biomedical medical diagnostics
    - microfluidics (nanoantennas can be fabricated as part of a microfluidic channel)
    - ultrasensitive detection
    - materials analysis
    - single photon source

## Advantages

- **High sensitivity** - high-contrast selection of single nanoemitters among 1000 background molecules
- **Flexibility in fluorophore design** because the nanoantennas facilitate detection of normally weakly emitting species
- **Large enhancement** - increases fluorescence up to a factor of 1340x (10x higher than with previous enhancers)
- **Optimally suited for fluorescence or emission enhancement**:
    - shape is specifically designed to achieve the highest electromagnetic field enhancements
    - controllable structure
    - amenable to integration

## Publications


- Anika Kinkhabwala, Z. Yu, S. Fan, and W.E. Moerner, "Fluorescence correlation spectroscopy at high concentrations using gold bowtie nanoantennas"*Chemical Physics*, Volume 406, October 8, 2012.
- Anika Kinkhabwala, Z. Yu, S. Fan, Y. Avlasevich, K. Mullen and W.E. Moerner, "Large single-molecule fluorescence enhancements produced by a bowtie nanoantenna", *Nature Photonics Letters*, published online 18 October 2009.


## Patents

- Published Application: 20120091365

## Innovators

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