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Biometallic Nano-Structures: A Thousand-Fold Fluorescence Enhancement with Nanopetals

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Although, metal nanoparticles have been shown to increase emission fluorescence of molecules due to the propagation of electron density waves, i.e. surface plasmons, at the interface between the metal and substrate, biometallic nanostructures yield a higher emission enhancement and can be suitable for measuring cell surfaces at the nano scale. We have developed a method to attain bimetallic structures on the surface of memory polymers in order to achieve sharp bi-layered uniaxial and biaxial nanopetals. The sharp edges of the nanopetals exhibit remarkable increase of emission intensity of fluorescent molecules. We observe several thousand fold increase in intensity at the edges or ‘‘hotspots’’ of both uniaxial and biaxial nanopetals. The fluorescence intensities observed at the hotspots are brief bursts of intensity as the molecules diffuse through the structures. These bursts are below the resolution limit of our optics and possibly be due to single molecular emission. The intensity of the bursts increases non-linearly with increase laser intensity suggesting that the events may be attributable to stimulated emission, excited-state absorption, or saturation intensity dependent 2-photon emission cross-section. We also show a decrease in the excited-state lifetime of the fluorescence particles, fluorescein, revealing strong plasmonic interactions. Our findings reveal an ultra-sensitive and novel technique using bimetallic nanopetals to enhance fluorescence detection.