Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Radiation rate enhancement in multilayered photonic and plasmonic nanopillars NATE LAWRENCE, LUCA DAL NEGRO, Department of Electrical Engineering, Boston University — We have systematically studied arrays of multilayered nanopillars composed of both metal and dielectic materials and shown that they can be used to enhance the radiative properties of active materials through modification of the local density of states (LDOS). Using an extension of the multipolar expansion method in two dimensions, we are able to calculate modifications in the radiation rate of emitters and power radiated to the far field. We show multi-resonant confinement of light to sub-wavelength gap regions inside nanopillars composed of alternating layers of metal and dielectric materials, forming a circular metal-insulator-metal (MIM) device. Sub-wavelength light confinement of 1.55μm radiation is also demonstrated in purely dielectric nanopillars with reduced optical losses using alternating layers of high and low refractive index materials. In both cases, we find that the LDOS can be strongly increased, modifying the radiative rate and the internal quantum efficiency of emitters. Using top-down electron beam lithography, reactive ion etching and sputtering deposition we have created for the first time high-aspect ratio, light emitting, multilayered nanopillar structures consisting of alternating Si and Er:SiNx layers. Using dark-field scattering and photoluminescence decay spectroscopy we have experimentally characterized the fabricated nanostructures and demonstrated ability to control their radiation properties. These results are important to enable novel Si-based optical cavities and light emitting structures with nanoscale light confinement for optical communications and sensing.

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Date submitted: 29 Nov 2012 Electronic form version 1.4