Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Coupled External Cavity Photonic Crystal Enhanced Fluorescence[1] ANUSHA POKHRIYAL, Department of Physics, University of Illinois at Urbana-Champaign, MENG LU, CHUN GE, BRIAN CUNNINGHAM, Department of Electrical and Computer Engineering, University of Illinois at Urbana-Champaign, NANO SENSORS GROUP TEAM — In this work we report a fundamentally new approach to enhance fluorescence in which surface adsorbed fluorophore-tagged biomolecules are excited on a photonic crystal surface that functions as a narrow bandwidth and tunable mirror of an external cavity laser. This scheme leads to $\sim$10x increase in the electromagnetic enhancement factor compared to ordinary photonic crystal enhanced fluorescence. In our experiments, the cavity automatically tunes its lasing wavelength to the resonance wavelength of the photonic crystal, ensuring optimal on-resonance coupling even in the presence of variable device parameters and variations in the density of surface-adsorbed capture molecules. We achieve $\sim 10^5$x improvement in the limit of detection of a fluorophore-tagged protein compared to its detection on an unpatterned glass substrate. The enhanced fluorescence signal and easy optical alignment make cavity-coupled photonic crystals a viable approach for further reducing detection limits of optically-excited light emitters that are used in biological assays.

[1]This work was supported by National Science Foundation (CBET11-32225) and the National Institutes of Health (R01 GM086382).

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Date submitted: 17 Oct 2012 Electronic form version 1.4