Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Excitonic Lasing in Solution-Processed Subwavelength Nanosphere Assemblies.[1] KANNATASSEN APPAVOO, CFN, Brookhaven National Laboratory, XIAOZE LIU, VINOD MENON, Dept. of Physics, City College of New York, MATTHEW SFEIR, CFN, Brookhaven National Laboratory — Lasing in solution-processed nanomaterials has gained significant interest because of the potential for low-cost integrated photonic devices. Still, a key challenge is designing low-threshold lasing devices based on a comprehensive understanding of the system's spectral and temporal dynamics. Here we show low-threshold random lasing in sub-wavelength thin films of coupled, highly crystalline zinc oxide nanospheres, with an overall thickness on the order of $\lambda/4$. The cavity-free geometry consists of 35nm zinc oxide nanospheres that collectively localize the in-plane emissive light fields while minimizing scattering losses, resulting in excitonic lasing with fluence thresholds at least an order of magnitude lower than previous UV-blue random and quantum-dot lasers. Fluence-dependent effects, as quantified by sub-picosecond transient spectroscopy, highlight the role of phonon-mediated processes in excitonic lasing. Sub-picosecond evolution of distinct lasing modes, together with 3D electromagnetic simulations, indicate a random lasing process - in violation of the commonly cited criteria of strong scattering from individual nanostructures. These results show that coupled nanostructures with high crystallinity can function as building blocks for high-performance optoelectronics.

[1]Research is carried out at the Center for Functional Nanomaterials, Brookhaven National Laboratory, which is supported by the U.S.DOE (DE-AC02-98CH10886). This work is supported by the National Science Foundation through Grant No. DMR 1410249.

Kannatassen Appavoo
CFN, Brookhaven National Laboratory

Date submitted: 07 Jan 2016 Electronic form version 1.4