Abstract Submitted
for the MAR06 Meeting of
The American Physical Society

Achieving a Photonic Band-Edge Near Visible Wavelengths by Copper Coating on 3D Tungsten Photonic-lattices. DEXIAN YE, SHAWN-YU LIN, JAMES BUR, TOH-MING LU, Rensselaer Polytechnic Institute — The fabrication of all-metal three-dimensional (3D) photonic lattices (PLs) is a subject that has raised great interest due to their potential in energy applications [1]. However, there are very few metals are suitable for the architecture of 3D PLs with a photonic band-edge near visible wavelengths. 3D tungsten (W) photonic lattice in "wood-pile" architecture has been successfully fabricated [1]. But the intrinsic limitation of W prevents the photonic band-edge to go beyond 2μm. We show that by material engineering this limitation can be overcome. We coated a very thin layer of copper (Cu) conformally onto the W PLs and modified their optical properties. The Cu thin films were coated on the PLs by electroless deposition. This thin Cu film ($\sim$70 nm) has dramatic effects on the photonic band-gap behavior of the W PLs. After the coating of Cu, the photonic lattice has a much larger photonic band-gap. The band-edge of the photonic lattice is shifted from $\lambda \sim$2μm to $\lambda \sim$750nm. Our experimental data agree with the predictions by finite difference time domain calculations. This method provides a new route for tailoring photonic properties and it should work for 3D PLs constructed from other materials.
[1] J. G. Fleming, S.Y. Lin, I. El-Kady, R. Biswas and K. M. Ho, ***Nature* 417**, 52-55 (2002).

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Date submitted: 21 Nov 2005 Electronic form version 1.4