Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Alternating gate-voltage effects on photoluminescence of air-suspended carbon nanotubes[1] M. JIANG, Y. KUMAMOTO, A. ISHII, M. YOSHIDA, Y.K. KATO, The University of Tokyo — Gate voltages cause quenching of photoluminescence in carbon nanotubes through phase-space filling and doping-induced exciton relaxation.[2] In this work, we apply square-wave voltages to partially gated nanotubes and find that such quenching can be eliminated at high frequencies. The devices are fabricated on a silicon-on-insulator substrate and we start by etching trenches through the top silicon layer into the buried oxide. The top silicon layer is thermally oxidized for use as the gate and we form an electrode on one side of the trench. From catalyst particles placed on the electrode, nanotubes are grown over the trench onto the gate. For square-wave voltages at low frequencies, photoluminescence quenching occurs as expected. When the frequency becomes higher, we observe that emission increases linearly and saturates above a threshold frequency. Time-averaging of the voltage cannot explain such an increase, as it also occurs when offset voltages are added to the square-wave. Furthermore, the threshold frequency increases as the excitation laser power is turned up. These observations could be explained by a model in which photocarriers are stored by the gate fields and voltage switching induces light emission.

[1]Work supported by KAKENHI, SCOPE, and the Photon Frontier Network Program of MEXT, Japan.
[2]S. Yasukochi et al., Phys. Rev. B 84, 121409(R) (2011).

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Date submitted: 14 Nov 2013 Electronic form version 1.4