# Criterion for removing a delayed peak from the nonlinear response of photonic crystal / quantum dot waveguides

Univ. of Electro-Communications (UEC), Dept. of Electronic Engineering[1]
Univ. of Tsukuba, Center for Tsukuba Advanced Research Alliance (TARA)[2]
National Institute for Materials Science (NIMS)[3]
○M. Honma[1], F. Salleras[1], J. Sakaguchi[1], Y. Ueno[1], Y. Kitagawa[2], N. Ozaki[2], K. Asakawa[2], N. Ikeda[3], Y. Sugimoto[2, 3]
honma@ultrafast.ee.uec.ac.jp

**Introduction:** All-optical switch is one of the key elements in future photonic networks. Recently, two-dimensional photonic crystal (PC) waveguides with embedded quantum dots (QDs) as optical nonlinear media have been operated with ultrafast switching speed and low pump energy [1]. To investigate ways to reduce energy consumption and switching time, we measured QD dynamics dependence on pump energy in PC/QD straight waveguides using sub-picosecond two-color pump and probe scheme. **Results:** Figure 1 shows pump transmittance as a function of pump power for a wavelength of 1290nm (resonant to QD absorption peak). Transmittance increases below ~200fJ/pulse by QD absorption saturation and decreases above ~200fJ/pulse due to the onset of two-photon absorption (TPA). Figure 2 shows QD absorption dynamics as a function of delay time between pump and probe for two different pump energies. For pump energy below TPA threshold (160fJ/pulse curve), absorption recovery has two different time scales of a few picosecond and above 100ps. Above TPA threshold (425fJ/pulse curve), it shows a 12ps delayed transmission peak related to capture time of high energy photo-carriers generated by TPA into the QDs. For ultrafast applications, this delayed peak is detrimental and should be avoided by restricting pump energies below TPA threshold.

[1] H. Nakamura et al., Opt. Exp. **12**, 6606 (2004)

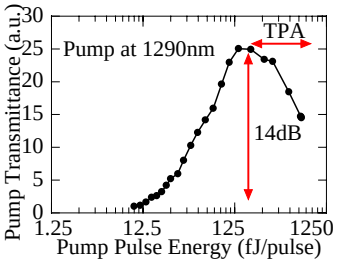


Fig. 1: Pump (1290nm) transmittance as a function of pump energy
TPA threshold at ~200fJ/pulse

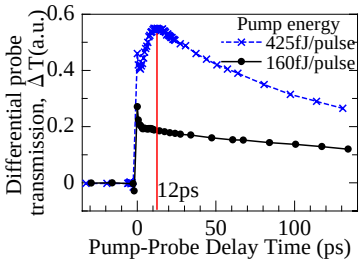


Fig. 2: Probe (1310nm, 1.25fJ) transmission for pump (1290nm) pulse energies 160fJ and 425fJ
TPA effects appeared delayed at ~12ps