Many-particle Effects in the Nonlinear Polarization Rotation in Semiconductor Quantum Well Bragg Structures

D.T. Nguyen, N.H. Kwong, Z.S. Yang, R. Binder

College of Optical Sciences and Department of Physics
The University of Arizona

A. L. Smirl

Laboratory for Photonics and Quantum Electronics
The University of Iowa

Supported by ONR, DARPA, JSOP, COEDIP
Bragg-spaced multiple quantum wells

One-dimensional resonant photonic bandgap structure

Switch Geometry

Control pulse $\sigma_+$

Input signal pulse (x-polarized)

Detector

y-polarizer

Reflected signal pulse (elliptically-polarized)

Bragg structure

All pulses in quasi-normal incidence
Pump-induced difference in the “+” and “−” signal reflectivities leads to a non-zero y-signal component

\[ E = \text{system leakage fraction} \quad \text{(typically } \sim 10^{-4}) \]

- Contrast ratio at lower edge \( \sim 10^4 \) or 40 dB
- Max. throughput is 12% of input x-signal intensity
- Switching time control-pulse width limited

(1) Nguyen, Kwong, Yang, Binder, Smirl, Appl. Phys. Lett. 90, 181116 (2007)
- Contrast ratio > 40 dB
- Max. throughput is 60% of input signal intensity
- Switching time ~ 1 ps (control-pulse width limited)
- Switching energy ~ 14 μJ/cm²
- T=10K